

DIRECTORY OF DISASTER-RELATED TECHNOLOGY



U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL DISASTER ASSISTANCE ADMINISTRATION

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DIRECTORY OF DISASTER-RELATED TECHNOLOGY



DEPARTMENT OF TECHNOLOGY AND PROGRAM DEVELOPMENT
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



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Project Titles Section

Selected Bibliography of Publications on Natural Hazards

USER GUIDE

Information in the Directory is arranged in the following sections: Geographic Areas, Functional Categories, Technological Categories, Disaster Types, Supporting Organizations, Performance Organizations, Investigations, and Project Titles.

Each project in the Directory is keyed to a unique reference number (e.g., F0806, F0005, F0001) that ties the sections together and in no special case, to all the elements of information contained in the Directory. The first digit in the number indicates the disaster type (e.g., F for Nuclear, C for Chemical, H for Multiple Hazard, and D for economic disaster), sequential in the order in which the project appears in the Disaster Type Section.

Following is a brief description of each section in the order of appearance in the Directory.

The **GEOGRAPHIC AREAS SECTION** refers to those locations in which the reported technology for application is available and where the investigation was conducted. The project listed in this section are therefore defined as having potential relevance for the specific geographic areas named. These names are: States, countries, U.S. metropolitan areas, cities, areas of alphabetic order, cities or counties, and a "miscellaneous subgroup" within the latter. The names are listed alphabetically in the project title, the name of the city rather than the metropolitan area. The names are listed in a certain order, what information is available in the Directory under a particular geographic area is indicated by this section.

The **FUNCTIONAL CATEGORIES SECTION** presents the information arranged in the Disaster Section by category: Individual Activities, Public Activities, Disaster Mitigation, and Hazard Reduction. These are defined categories and not a means of classifying. Each Category Division is further subdivided into Functional Categories within the Activities section. The number in the project title refers to the numbering of alphabetic listing in the category, and the number in the subordinate term of the project title refers to the alphabetical listing. All references are provided for the project title and the project title is simply a reference to the project title. For example, a project in the category of "Disaster Mitigation" would have the project title "Disaster Mitigation" and the number in the project title would be "F0806".

appearing on a left hand page is printed in the upper left hand corner of that page, the last high level term on the right hand page appears on the upper right hand corner of the page.

The **TECHNOLOGY CATEGORIES SECTION** is similar to the Functional Categories Section in structure, but the hierarchical system used to arrange the information was developed by NED and has been employed in other editions of this type of list and the NED reference is also provided. The section is divided into two parts: one for the first half of the information and the second half of the information. The first half of the information is divided into two parts: one for the first half of the information and the second half of the information. The second half of the information is divided into two parts: one for the first half of the information and the second half of the information.

The **DISASTER TYPES SECTION** contains the first half of the information and the second half of the information. Each project is divided into two parts: one for the first half of the information and the second half of the information. The first half of the information is divided into two parts: one for the first half of the information and the second half of the information. The second half of the information is divided into two parts: one for the first half of the information and the second half of the information. The first half of the information is divided into two parts: one for the first half of the information and the second half of the information. The second half of the information is divided into two parts: one for the first half of the information and the second half of the information.

The **SUPPORTING ORGANIZATION SECTION** contains the second half of the information and the third half of the information. Each project is divided into two parts: one for the first half of the information and the second half of the information. The first half of the information is divided into two parts: one for the first half of the information and the second half of the information. The second half of the information is divided into two parts: one for the first half of the information and the second half of the information.

SECTION consists of two parts: an alphabetical listing of performing organizations with reference numbers for the projects, and an alphabetical listing within each disaster type.

The **INVESTIGATOR/AUTHOR SECTION** also consists of two parts: the single alphabetical listing for the whole Directory and the alphabetical listing of investigators within each disaster type. Where the project was a group effort or no investigator was provided, the designation "Unknown" appears.

The **PROJECT TITLE LIST SECTION** is an alphabetical listing of all the projects in the Directory,

project or report summary. Each line is followed by a reference number referring to the full project or report summary in the Disaster Types Section.

All of the sections of the Directory were generated by computer, necessitating a limitation on the number of characters available for terms and captions; in some instances, therefore, abbreviations were used.

A bibliography, arranged by disaster types, is provided for those users who seek additional information on a number of topics related to natural disasters.

SAMPLES FROM MAJOR DISASTER TYPES SECTION

Subsection and Disaster Type

Functional Category

Reference Number

Project Title

Investigator

Performing Organization

Project Summary (Ongoing)

Supporting Organization

6. FLOODS

PUBLIC ASSISTANCE

60000 FLOOD DAMAGE STUDY

60000 U.S. Dept. of Commerce, Technical Division, Flood Control Administration, Washington, D.C.

The study is a preliminary study of the effects of flood damage on the economy of the United States. It is a study of the effects of flood damage on the economy of the United States. It is a study of the effects of flood damage on the economy of the United States.

Approved by Department of Commerce, Technical Division, Flood Control Administration, Washington, D.C. It is a study of the effects of flood damage on the economy of the United States. It is a study of the effects of flood damage on the economy of the United States.

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SUPPLEMENTED BY 60000 FLOOD DAMAGE STUDY

6. FLOODS

PUBLIC ASSISTANCE

60020 FLOOD DAMAGE STUDY, WASHINGTON, D.C.

60020 U.S. Dept. of Commerce, Technical Division, Flood Control Administration, Washington, D.C.

The study is a preliminary study of the effects of flood damage on the economy of the United States. It is a study of the effects of flood damage on the economy of the United States. It is a study of the effects of flood damage on the economy of the United States.

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Approved by Department of Commerce, Technical Division, Flood Control Administration, Washington, D.C.

Approved by Department of Commerce, Technical Division, Flood Control Administration, Washington, D.C.

Approved by Department of Commerce, Technical Division, Flood Control Administration, Washington, D.C.

Project Abstract (Completed)

Availability

Alabama

5 SPECIAL MICROEARTHQUAKE NETWORKS - ALABAMA AND TEXAS

C. ROLLER, U.S. Dept. of the Interior, Geological Survey

1 PROFILING THE FOREST INCENDIARIST - AN ANALYSIS OF DOCUMENTED CASE HISTORIES

DUNKELBERGER, Auburn University, Agricultural Experiment Sta.

4 FLOOD-FREQUENCY SYNTHESIS FOR SMALL STREAMS - ALABAMA

O. MING, U.S. Dept. of the Interior, Geological Survey

5 ELEMENTS OF THE WATER RESOURCES SITUATION IN ALABAMA

B. KNOWLES, State Geol. Survey

7 STUDY OF GUIDELINES FOR LAND MANAGEMENT AND USE OF FLOOD-PRONE AREAS IN ALABAMA

P. SNOOP, Auburn University, Center For Urban & Reg. Plan.

8 A GUIDE FOR REDUCING FLOOD DAMAGE IN THE SOUTH ALABAMA REGION

UNKNOWN, South Alabama Reg. Plan. Comm.

9 FLOOD MANAGEMENT STUDY

UNKNOWN, Tuscaloosa Area Coun. of Gov.

10 FLOOD MANAGEMENT STUDY - TUSCALOOSA, PICKENS COUNTY AND MOUNDSVILLE, ALABAMA, MAY 1971

UNKNOWN, Tuscaloosa Area Coun. of Gov.

11 FLOODWAY EVALUATIONS BEFORE & AFTER CHANNEL MODIFICATIONS ASSUMING TOTAL METROPOLITAN DEVELOPMENT IN DRAINAGE BASINS JEFFERSON COUNTY, ALABAMA

A.L. KNIGHT, U.S. Dept. of the Interior, Geological Survey

12 LAND-USE REGULATIONS IN FLOOD-PRONE AREAS - A SUMMARY OF THE WISCONSIN STUDY AND AN ANALYSIS OF ALABAMA LAND-USE LAW

COHEN, Univ. of Alabama, Natural Resources Center

13 FLOOD FREQUENCY OF ALABAMA STREAMS - ALABAMA

F. MCCAIN, U.S. Dept. of the Interior, Geological Survey

14 FLOOD FREQUENCY SYNTHESIS FOR SMALL STREAMS - ALABAMA

O. MING, U.S. Dept. of the Interior, Geological Survey

17 EARLY DETECTION AND CORRECTION OF SINKHOLE PROBLEMS - ALABAMA

G. NEWTON, U.S. Dept. of the Interior, Geological Survey

Baldwin County

27 PRELIMINARY STORM DRAINAGE AND FLOOD CONTROL PLAN - UNION COUNTY, N.J.

E.T. KILLAM, Union County Planning Board

6.0158 A GUIDE FOR REDUCING FLOOD DAMAGE IN THE SOUTH ALABAMA REGION

UNKNOWN, South Alabama Reg. Plan. Comm.

Escambia County

6.0127 PRELIMINARY STORM DRAINAGE AND FLOOD CONTROL PLAN - UNION COUNTY, N.J.

E.T. KILLAM, Union County Planning Board

6.0158 A GUIDE FOR REDUCING FLOOD DAMAGE IN THE SOUTH ALABAMA REGION

UNKNOWN, South Alabama Reg. Plan. Comm.

Hale County

6.0160 FLOOD MANAGEMENT STUDY - TUSCALOOSA, PICKENS COUNTY AND MOUNDSVILLE, ALABAMA, MAY 1971

UNKNOWN, Tuscaloosa Area Coun. of Gov.

Jefferson County

6.0161 FLOODWAY EVALUATIONS BEFORE & AFTER CHANNEL MODIFICATIONS ASSUMING TOTAL METROPOLITAN DEVELOPMENT IN DRAINAGE BASINS JEFFERSON COUNTY, ALABAMA

A.L. KNIGHT, U.S. Dept. of the Interior, Geological Survey

Mobile County

6.0127 PRELIMINARY STORM DRAINAGE AND FLOOD CONTROL PLAN - UNION COUNTY, N.J.

E.T. KILLAM, Union County Planning Board

6.0158 A GUIDE FOR REDUCING FLOOD DAMAGE IN THE SOUTH ALABAMA REGION

UNKNOWN, South Alabama Reg. Plan. Comm.

Moundsville

6.0160 FLOOD MANAGEMENT STUDY - TUSCALOOSA, PICKENS COUNTY AND MOUNDSVILLE, ALABAMA, MAY 1971

UNKNOWN, Tuscaloosa Area Coun. of Gov.

Pickens County

6.0160 FLOOD MANAGEMENT STUDY - TUSCALOOSA, PICKENS COUNTY AND MOUNDSVILLE, ALABAMA, MAY 1971

UNKNOWN, Tuscaloosa Area Coun. of Gov.

Alafia River

- 6.0234 HYDROGRAPH MODEL STUDIES OF THE HILLSBOROUGH, ALAFIA, AND ANCLOTE RIVER BASINS, FLORIDA
J.F. TURNER, U.S. Dept. of the Interior, Geological Survey

Alaska

- 1.0007 PUGET PEAK AVALANCHE, ALASKA
M.C. HOYER, Arizona State University, School of Liberal Arts
- 1.0010 SURFICIAL GEOLOGY OF JUNEAU AND VICINITY URBAN AREA, ALASKA
R.D. MILLER, U.S. Dept. of the Interior, Geological Survey
- 3.0018 STRUCTURAL EFFECTS OF THE FAIRBANKS, ALASKA EARTHQUAKE OF JUNE 21, 1967
UNKNOWN, John A. Blume & Associates
- 3.0070 CRUSTAL DEFORMATION RELEASE, FAILURE AND TILTS IN ALASKA
E. BERG, Univ. of Alaska, Geophysical Institute
- 3.0071 EVALUATION OF FEASIBILITY OF MAPPING SEISMICALLY ACTIVE FAULTS IN ALASKA
L. GEDNEY, Univ. of Alaska, Geophysical Institute
- 3.0072 INSTALLATION AND OPERATION OF A TELEMETERED SEISMIC NETWORK ON THE ALASKA PENINSULA
UNKNOWN, Univ. of Alaska, Geophysical Institute
- 3.0094 EFFECTS OF SOIL CONDITIONS ON GROUND MOTIONS DURING EARTHQUAKES - ALASKA AND CALIFORNIA
H.B. SEED, Univ. of California, Inst. of Trans. & Traf. Engrg.
- 3.0131 TECTONIC HISTORY - NORTH PACIFIC CONTINENTAL MARGIN - ALASKA
R. VONHUENE, U.S. Dept. of the Interior, Geological Survey
- 3.0172 GREATER ANCHORAGE AREA BOROUGH, ALASKA
E. DOBROVOLNY, U.S. Dept. of the Interior, Geological Survey
- 3.0186 TOWARD REDUCTION OF LOSSES FROM EARTHQUAKES
UNKNOWN, Natl. Acad. of Sciences
- 3.0220 ALEUTIAN SEISMICITY - MILROW SEISMIC EFFECTS
E.R. ENGDAHL, U.S. Dept. of Commerce, Natl. Ocean Survey
- 3.0221 THE FAIRBANKS, ALASKA, EARTHQUAKES OF JUNE 21, 1967
J.N. JORDAN, U.S. Dept. of Commerce, Natl. Ocean Survey
- 3.0222 IMPROVED BODY-WAVE MAGNITUDES OF ALEUTIAN EARTHQUAKES
3.0224 ALEUTIAN SEISMIC PROGRAM - SEISMOLOGICAL BULLETIN, MARCH 1971
UNKNOWN, U.S. Dept. of Commerce, Environ. Research Laboratories
- 3.0247 ALEUTIAN SEISMIC PROGRAM HYPOCENTER SUMMARY, OCTOBER 1972-APRIL 1973
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 3.0259 MEASUREMENTS FOR FAULT SLIP ON THE DENALI, FAIRWEATHER, AND CASTLE MOUNTAIN FAULTS, ALASKA
R. PAGE, Columbia University, Lamont Doherty Geol. Observ.
- 3.0262 A COMPREHENSIVE STUDY OF THE SEISMOTECTONICS OF THE ALEUTIAN ARC - ALASKA
L.R. SYKES, Columbia University, Lamont Doherty Geol. Observ.
- 5.0013 STUDIES OF IMAGES OF SHORT-LIVED EVENTS USING ERTS DATA - ALASKA
W.A. DEUTSCHMAN, Smithsonian Institution
- 5.0019 METHODS FOR THE PREVENTION AND CONTROL OF LIGHTNING FIRES
R.G. BAUGHMAN, U.S. Dept. of Agriculture, Internat. For. & Rg. Exp. Sta.
- 6.0053 CHENA RIVER LAKES PROJECT, ALASKA - PROBLEMS RELATING TO CHANNEL DEVELOPMENT, EROSION, & BANK & LEVEE PROTECTION
C.P. LINDNER, U.S. Army, Corps of Engineers
- 6.0163 DEVELOPMENT OF AN ALASKAN CONCEPTUAL WATERSHED MODEL
R.F. CARLSON, Univ. of Alaska, Inst. of Water Resources
- 6.0212 INVESTIGATION OF SCOUR AT BRIDGES IN ALASKA
L.S. LEVEEN, U.S. Dept. of the Interior, Geological Survey
- 9.0024 MECHANICS OF DEBRIS AVALANCHING IN SHALLOW TILL SOILS OF SOUTHEAST ALASKA
D.N. SWANSTON, U.S. Dept. of Agriculture, Pac. N.W. For. & Rg. Exp. Sta.
- 9.0060 ENVIRONMENTAL INFLUENCES ON STABILITY OF SOIL MASSES - ALASKA AND OHIO
T.H. WU, Ohio State University, School of Engineering
- 10.0025 STUDIES ON THE FLUVIAL ENVIRONMENT, ARCTIC COASTAL PLAIN PROVINCE, NORTHERN ALASKA VOLUME I
R.J. LEWELLEN, Arctic Inst. of North America
- 13.0006 TRANS-ALASKA PIPELINE - SUPPLEMENTAL EXHIBITS AND TESTIMONY - VOLUME V
UNKNOWN, U.S. Dept. of the Interior
- 13.0013 ALASKA GEOLOGIC EARTHQUAKE HAZARDS
G. PLAFKER, U.S. Dept. of the Interior, Geological Survey
- 13.0017 ENGINEERING GEOLOGY RECONNAISSANCE STUDIES OF COASTAL COMMUNITIES, ALASKA
R.W. LEMKE, U.S. Dept. of the Interior, Geological Survey
- 13.0018 RECONNAISSANCE ENGINEERING GEOLOGY OF THE SITKA AREA, ALASKA
J.T. MCGILL, U.S. Dept. of the Interior, Geological Survey

SEISMIC STUDIES

R. H. WHITT U.S. Army Waterway Experiment Station

140002 SEISMIC SURVEILLANCE OF VOLCANIC SURVEILLANCE
ALASKA, HAWAII AND WASHINGTON

F. L. RUGG U.S. Dept. of the Interior, Geological Survey

140008 SEISMIC SURVEILLANCE OF VOLCANIC ACTIVITY
IN THE ALASKA SUBARCTIC VOLCANIC ZONE, COOK INLET,
ALASKA

J. K. MEYER Univ. of Alaska, Geophysical Institute

140014 REGIONAL VOLCANOLOGY - WESTERN
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R. L. SMITH U.S. Dept. of the Interior, Geological Survey

150011 SHORT TERM CLIMATE CHANGES AND
COASTAL EROSION, BARROW, ALASKA

ED. HUMM Arctic Inst. of North America

150022 COASTAL EROSION - FORMS OF SEDIMENT
ACCUMULATION ON THE BEACH ZONE
ALASKA, NEW ZEALAND

M. C. HULL Univ. of Michigan, Dept. of Geological Engineering
Lansing

Methods

50001 EFFECTS OF SOIL CONDITIONS ON GROUND
MOTION DURING EARTHQUAKE - ALASKA AND
CALIFORNIA

H. H. MEYER Univ. of Oregon, Dept. of Civil Engineering,
Eugene

50002 GREATERT - APTODONGAL - APTKA - GEOLOGICAL
ALASKA

E. L. BORDOWITZ U.S. Dept. of Commerce, Bureau of
Mineral Resources

Hazards

150014 SHORT TERM CLIMATE CHANGES AND
COASTAL EROSION, BARROW, ALASKA

ED. HUMM Arctic Inst. of North America

Investigation

50010 APOCALYPTIC EFFECTS OF THE EARTHQUAKE
ALASKA EARTHQUAKE OF 1964 - 1965

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50221 THE EARTHQUAKE ALASKA EARTHQUAKE OF
1964 - 1965

J. K. AND J. K. U.S. Dept. of Commerce, Bureau of
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80003 CHUKA RIVER FLOOD PROBLEMS - ALASKA
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50003 THE HISTORY OF THE PACIFIC
OCEANIC SEISMICITY - ALASKA

R. L. SMITH U.S. Dept. of the Interior, Geological Survey

50220 ALUTIAN SEISMICITY - BARROW SEISMICITY

J. K. AND J. K. U.S. Dept. of Commerce, Bureau of
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50222 IMPROVED BODY WAVE SEISMICITY
ALUTIAN EARTHQUAKES

J. K. AND J. K. U.S. Dept. of Commerce, Bureau of
Mineral Resources

50223 ALUTIAN SEISMIC PROGRAM SEISMIC
CALIBRATION SEARCH 1972

LEONARD F. K. AND J. K. AND J. K. U.S. Dept. of Commerce, Bureau of
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50224 ALUTIAN SEISMIC PROGRAM SEISMIC
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LEONARD F. K. AND J. K. AND J. K. U.S. Dept. of Commerce, Bureau of
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50243 ALUTIAN SEISMIC PROGRAM HYPOCENTRIC
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50262 A COMPREHENSIVE STUDY OF
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140005 THE NAME RESEARCH
J. K. AND J. K. U.S. Dept. of Commerce, Bureau of
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- 6.0234 HYDROGRAPH MODEL STUDIES OF THE HILLSBOROUGH, ALAFIA, AND ANCILOTE RIVER BASINS, FLORIDA
J.F. TURNER, U.S. Dept. of the Interior, Geological Survey

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- 3.0277 SEISMICITY STUDIES OF THE CENTRAL APPALACHIAN REGION
G.A. BOLLINGER, Virginia Polytechnic Institute, School of Arts
- 15.0039 SEDIMENT MOVEMENT AND HILLSLOPE MORPHOLOGY IN THE CENTRAL APPALACHIAN REGION - VIRGINIA
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

Appalachian System

- 2.0024 METEOROLOGICAL DROUGHT IN TENNESSEE
J.V. VAIKSNORAS, U.S. Dept. of Commerce, Natl. Weather Service
- 3.0236 A MICROEARTHQUAKE STUDY OF THE LOWER MISSISSIPPI VALLEY - ARKANSAS, MISSISSIPPI AND TENNESSEE
O.W. NUTTLI, St. Louis University, Graduate School
- 6.0400 URBAN HYDROLOGY OF STREAMS IN FAIRFAX COUNTY
P.L. SOULE, U.S. Dept. of the Interior, Geological Survey

Arctic

- 10.0025 STUDIES ON THE FLUVIAL ENVIRONMENT, ARCTIC COASTAL PLAIN PROVINCE, NORTHERN ALASKA VOLUME I
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- 2.0008 PROJECT ARID DROP, A SUMMARY REPORT OF CLOUD SEEDING ACTIVITIES IN ARIZONA AS CONDUCTED BY ATMOSPHERICS INCORPORATED (ABBREV)
T.J. HENDERSON, Atmospherics Incorporated
- 3.0163 RISK MAPS AND FIELD INVESTIGATIONS
S.T. ALGERMISSEN, U.S. Dept. of the Interior, Geological Survey
- 3.0166 GLEN CANYON AND AUBURN DAM SEISMICITY - COLORADO

- 10.0014 ARIZONA EARTH FISSURE INVESTIGATION
C. WINIKKA, State Highway Department
- 12.0010 ARIZONA 'EDDY' TORNADOES
R.S. INGRAM, U.S. Dept. of Commerce, Natl. vice

TEMPE

- 12.0010 ARIZONA 'EDDY' TORNADOES
R.S. INGRAM, U.S. Dept. of Commerce, Natl. vice

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- 3.0174 NEW MADRID EARTHQUAKE - ARKANSAS, KENTUCKY, MISSISSIPPI, MISSOURI, TENNESSEE
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- 3.0236 A MICROEARTHQUAKE STUDY OF THE LOWER MISSISSIPPI VALLEY - ARKANSAS, MISSISSIPPI AND TENNESSEE
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- 3.0269 EARTHQUAKE RISK EVALUATION OF DEN COUNTY, ARKANSAS, DESOTO COUNTY, MISSISSIPPI, AND SHELBY COUNTY, TENNESSEE
F. KELLOGG, Mississippi Ark. Tenn. Council
- 3.0270 REGIONAL EARTHQUAKE RISK STUDY OF MISSOURI, ARKANSAS, KENTUCKY, TENNESSEE, MISSISSIPPI AREA
UNKNOWN, Mississippi Ark. Tenn. Council
- 6.0100 RED RIVER EMERGENCY BANK PROTECTION - LOUISIANA, ARKANSAS, AND TEXAS
UNKNOWN, U.S. Army, Engineer District

CRITTENDEN COUNTY

- 3.0269 EARTHQUAKE RISK EVALUATION OF DEN COUNTY, ARKANSAS, DESOTO COUNTY, MISSISSIPPI, AND SHELBY COUNTY, TENNESSEE
F. KELLOGG, Mississippi Ark. Tenn. Council

Atlantic Coastal Plain

- 3.0243 THE EFFECT OF GEOLOGIC STRUCTURE ON THE OCCURRENCE OF FRESH GROUNDWATER IN POST-OLIGOCENE DEPOSITS OF THE ATLANTIC COASTAL PLAIN
P.H. JONES, U.S. Dept. of the Interior, Geological Survey

Atlantic Ocean

- 8.0005 ATLANTIC HURRICANE SEASON OF 1969
R.H. SIMPSON, U.S. Dept. of Commerce, Service
- 8.0084 ATLANTIC TROPICAL SYSTEMS OF 1969

8.0086 COMPUTER METHODS APPLIED TO ATLANTIC AREA TROPICAL STORM AND HURRICANE CYCLOLOGY

TR. HOPE U.S. Dept. of Commerce, Seal Weather Service

8.0091 STATISTICAL DYNAMICAL PREDICTIONS OF HURRICANE TRACKS

C. J. MUMFIS U.S. Dept. of Commerce, Seal Hurricane Center

8.0115 MARINE CONSTRUCTIONS AND AUTOMATED FORECASTS FOR THE ATLANTIC COASTAL STORMS OF FEBRUARY 1977

A. L. POORE U.S. Dept. of Commerce, Technology Development Lab

8.0132 ATLANTIC HURRICANE TROPICAL CYCLONE MONITORING U.S. COAST GUARD

R.H. SIMPSON U.S. Dept. of Commerce, Seal Weather Service

Baker River

11.0001 PHYSICAL EVALUATION OF A COAST GUARD TROPICAL COOL MODERNIZED COORDINATE MONITORING THE CASPINE PROJECT

PL. THOMAS Univ. of Washington, School of Agr.

Bay St. Louis

8.0012 CHANGE IN DENSITY A REEVALUATION FOR GULFPORT MISSISSIPPI TO DETERMINE THE DENSITY OF HURRICANE CAMILLE NOVEMBER 13, 1969

UNKNOWN U.S. Dept. of Commerce

8.0078 WIND AND STORM DAMAGE TO THE HURRICANE CAMILLE

HO. THOMAS U.S. Dept. of Commerce, Seal Weather Service, Gulfport

Bayou Lafourche

8.0090 CHANGES IN THE FLANK AND VORTICITY OF HURRICANE PROTECTOR ASSOCIATED WATER TUNNEL DANCE, LAFORCHE, LOUISIANA, AND OTHERS

UNKNOWN U.S. Army, Eng. Corps, Gulfport

Beech River

8.0368 BEECH RIVER WATERSHED PROJECT - TENNESSEE

C. H. SMITH U.S. Geological Survey, Nashville

Bering Sea

Biscayne Bay

6.0020 STUDIES OF THE BIRD ALONG IN BAY

L. THORNTON Univ. of Miami, School of Marine

Bluterrort River

6.0021 TROPICAL STORMS AND PLANT LIFE IN THE 100 YEAR PASTORAL LIFE OF THE BLUTERRORT VALLEY, MONTANA
K. M. SMITH Montana State University, Bozeman

Black Hills

6.0026 BLACK HILLS TROPICAL BIRD LIFE IN THE 100 YEAR PASTORAL LIFE OF THE BLUTERRORT VALLEY, MONTANA
K. M. SMITH Montana State University, Bozeman

Brazos River

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UNKNOWN, U.S. Dept. of Commerce, Environ. Research
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- 3.0157 AN INVESTIGATION OF THE SEISMICITY & EARTHQUAKE HAZARDS OF THE SANTA BARBARA CHANNEL REGION - CALIFORNIA
A. SYLVESTER, Univ. of California, School of Letters

SANTA BARBARA COUNTY

- 6.0182 SEA COAST PLANNING PROJECT - CALIFORNIA
C. HETRICK, Univ. of California, School of Letters

SANTA ROSA

- 3.0025 THE SANTA ROSA, CALIFORNIA, EARTHQUAKES OF OCTOBER 1, 1969
K.V. STEINBRUGGE, U.S. Dept. of Commerce, Natl. Ocean Survey

VENTURA COUNTY

- 9.0029 GEOLOGY OF THE POINT DUME QUADRANGLE AND THE LOS ANGELES COUNTY PART OF THE TRIUNFO PASS QUADRANGLE, LOS ANGELES CO. COOPERATIVE, CALIFORNIA
R.H. CAMPBELL, U.S. Dept. of the Interior, Geological Survey

Caribbean Sea

- 8.0066 INVESTIGATION OF SATELLITE OBSERVED TYPHOON-HURRICANE CLOUD CLUSTERS AND FLOW FEATURES
W.M. GRAY, Colorado State University, School of Engineering
- 8.0086 COMPUTER METHODS APPLIED TO ATLANTIC AREA TROPICAL STORM AND HURRICANE CLIMATOLOGY
J.R. HOPE, U.S. Dept. of Commerce, Natl. Weather Service
- 8.0107 HURRICANE MODIFICATION RESEARCH (PROJECT STORMFURY)
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.
- 8.0122 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES (FOR SELECTED STATIONS AND THE MONTH OF SEPTEMBER)
H.I. CRUTCHER, U.S. Dept. of Commerce, Natl. Climatic Center

- 1.0006 AVALANCHES ON THE NORTH CASCADES HIGHWAY (SR-20) - SUMMARY REPORT
E.R. LACHAPPELLE, State Dept. of Highways

- 1.0009 THERMAL SURVEILLANCE OF ACTIVE VOLCANOES

J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey

- 1.0011 WATER YIELD IMPROVEMENT AND AVALANCHE HAZARD PREDICTION IN ALPINE AREAS OF THE ROCKY MOUNTAINS

M. MARTINELLI, Colorado State University, U.S.D.A. Rocky Mtn. For. Sta.

- 1.0014 AVALANCHE CONTROL IMPLEMENTATION STUDY

E. LACHAPPELLE, State Dept. of Highways

- 3.0080 SEISMICITY OF MENDOCINO ESCARPMENT-GORDA RIDGE REGION - CALIFORNIA

E.G. KEITH, Univ. of California, Seismographic Station

- 3.0266 SEISMICITY INVESTIGATIONS IN THE CASCADE MOUNTAINS AND VICINITY, OREGON, 1 MAY 1969 - 30 APRIL 1970

H.R. BLANK, Univ. of Oregon, School of Liberal Arts

- 3.0280 A STUDY OF SEISMICITY AND CRUSTAL STRUCTURE IN WESTERN WASHINGTON USING A SEISMIC TELEMETRY NETWORK

R.S. CROSSON, Univ. of Washington, School of Arts

- 9.0051 EFFECTS OF DEFORESTATION ON THE STABILITY OF NATURAL SLOPES - OREGON, WASHINGTON

D.H. GRAY, Univ. of Michigan, School of Engineering

- 11.0007 PHYSICAL EVALUATION OF CLOUD SEEDING TECHNIQUES FOR MODIFYING OROGRAPHIC SNOWFALL - THE CASCADE PROJECT

P.V. HOBBS, Univ. of Washington, School of Arts

- 14.0006 GEODIMETER STUDIES OF CASCADE VOLCANOES - WASHINGTON, OREGON AND CALIFORNIA

D.A. SWANSON, U.S. Dept. of the Interior, Geological Survey

- 14.0007 VOLCANIC HAZARDS IN THE CASCADE RANGE - CALIFORNIA AND WASHINGTON

D.R. CRANDELL, U.S. Dept. of the Interior, Geological Survey

- 14.0016 SEISMIC ACTIVITY OF THE CASCADE VOLCANOES

S.W. SMITH, Univ. of Washington, School of Arts

Central United States

- 3.0233 STATE-OF-THE-ART FOR ASSESSING EARTHQUAKE HAZARDS IN THE UNITED STATES. REPORT 1.

O.W. NUTTLI, U.S. Army, Waterways Experiment Station

- 3.0235 SOME GROUND MOTION AND INTENSITY RELATIONS FOR THE CENTRAL UNITED STATES

A. NECIOGLU, St. Louis University, Graduate School

C.E. ANDERSON, Univ. of Wisconsin, School of Natural Sciences

9.0042 DENVER METROPOLITAN AREA, COLORADO
R.M. LINDVALL, U.S. Dept. of the Interior, Geological Survey

9.0044 DENVER-FRONT RANGE URBAN CORRIDOR
T.W. OFFIELD, U.S. Dept. of the Interior, Geological Survey

10.0004 COAL MINE DEFORMATION STUDIES, SOMERSET, COLORADO
C.R. DUNRUD, U.S. Dept. of the Interior, Geological Survey

ADAMS COUNTY

6.0187 FLOOD FREQUENCY IN URBAN AREAS - COLORADO
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

ARAPAHOE COUNTY

6.0187 FLOOD FREQUENCY IN URBAN AREAS - COLORADO
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

BOULDER COUNTY

6.0187 FLOOD FREQUENCY IN URBAN AREAS - COLORADO
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

COLORADO SPRINGS

4.0005 DENVER URBAN CORRIDOR STUDIES - COLORADO
W.R. HANSEN, U.S. Dept. of the Interior, Geological Survey

DENVER

3.0217 DENVER EARTHQUAKES
L.E. GARONO, U.S. Army

3.0272 EARTHQUAKES INDUCED BY UNDERGROUND FLUID INJECTION
W.C. MCCLAIN, Oak Ridge National Laboratory

4.0005 DENVER URBAN CORRIDOR STUDIES - COLORADO
W.R. HANSEN, U.S. Dept. of the Interior, Geological Survey

6.0048 FLOOD FREQUENCY IN URBAN AREAS, COLORADO
G.L. DUCRET, U.S. Dept. of the Interior, Geological Survey

9.0042 DENVER METROPOLITAN AREA, COLORADO
R.M. LINDVALL, U.S. Dept. of the Interior, Geological Survey

9.0044 DENVER-FRONT RANGE URBAN CORRIDOR
T.W. OFFIELD, U.S. Dept. of the Interior, Geological Survey

DENVER COUNTY

DOUGLAS COUNTY

6.0187 FLOOD FREQUENCY IN URBAN AREAS - COLORADO
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

F.E. COLLINS

4.0005 DENVER URBAN CORRIDOR STUDIES - COLORADO
W.R. HANSEN, U.S. Dept. of the Interior, Geological Survey

JEFFERSON COUNTY

6.0187 FLOOD FREQUENCY IN URBAN AREAS - COLORADO
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

LOGAN COUNTY

7.0014 NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING
UNKNOWN, U.S. Natl. Science Foundation

MORGAN COUNTY

7.0014 NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING
UNKNOWN, U.S. Natl. Science Foundation

WELD COUNTY

7.0014 NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING
UNKNOWN, U.S. Natl. Science Foundation

Connecticut

6.0118 ANSONIA-DERBY LOCAL PROTECTION PROJECT, NAUGATUCK AND HOUSATONIC RIVERS - CONNECTICUT - HYDRAULIC MODEL INVESTIGATION
G.A. PICKERING, U.S. Army, Waterways Experiment Station

6.0192 RECOMMENDED REGIONAL PLAN FOR SEWERAGE, WATER SUPPLY AND STORAGE DRAINAGE - CONNECTICUT
UNKNOWN, Valley Regional Planning Agency

6.0193 SMALL STREAM FLOOD CHARACTERISTICS
M.D. THOMAS, U.S. Dept. of the Interior, Geological Survey

6.0210 PEAK FLOW FROM SMALL DRAINAGE AREAS - CONNECTICUT
J. HORTON, U.S. Dept. of the Interior, Geological Survey

8.0034 HURRICANE PROTECTION PROJECT, STRATFORD, CONNECTICUT
UNKNOWN, U.S. Army, New England Division

ANSONIA

SEWERAGE, WATER SUPPLY AND STORM DRAINAGE - CONNECTICUT
UNKNOWN, Valley Regional Planning Agency.

DERBY

- 6.0118 ANSONIA-DERBY LOCAL PROTECTION PROJECT, NAUGATUCK AND HOUSATONIC RIVERS, CONNECTICUT - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station

- 6.0192 RECOMMENDED REGIONAL PLAN FOR SEWERAGE, WATER SUPPLY AND STORM DRAINAGE - CONNECTICUT

UNKNOWN, Valley Regional Planning Agency.

NEW LONDON

- 8.0037 NEW LONDON HURRICANE PROTECTION PROJECT, NEW LONDON, CONNECTICUT

UNKNOWN, U.S. Army, New England Division

SEYMOUR

- 6.0192 RECOMMENDED REGIONAL PLAN FOR SEWERAGE, WATER SUPPLY AND STORM DRAINAGE - CONNECTICUT

UNKNOWN, Valley Regional Planning Agency.

SHELTON

- 6.0192 RECOMMENDED REGIONAL PLAN FOR SEWERAGE, WATER SUPPLY AND STORM DRAINAGE - CONNECTICUT

UNKNOWN, Valley Regional Planning Agency.

STRATFORD

- 8.0034 HURRICANE PROTECTION PROJECT, STRATFORD, CONNECTICUT

UNKNOWN, U.S. Army, New England Division

Connecticut River

- 6.0105 FLOOD PROOFING DECISIONS UNDER UNCERTAINTY - AN APPLICATION TO THE CONNECTICUT RIVER BASIN

P. AKILU, Univ. of Massachusetts, Water Resources Research Ctr.

- 6.0173 COMPUTER SIMULATION MODEL FOR FLOOD PLAIN DEVELOPMENT - PART II - MODEL DESCRIPTION AND APPLICATIONS

N.V. ARVANITIDIS, IN T A S A Incorporated

- 6.0291 ECONOMIC AND LEGAL ANALYSIS OF ALTERNATIVE FLOOD CONTROL STRATEGIES

- 6.0293 LEGAL ISSUES ON ECONOMIC UTILIZATION OF THE CONNECTICUT RIVER FLOOD PLAINS

D. WILKES, Univ. of Massachusetts, Man & His Environment Inst.

- 6.0294 LEGAL FACTORS IN ECONOMETRIC MODELING OF LOCAL FLOODPLAIN MANAGEMENT DEVICES IN THE CONNECTICUT RIVER BASIN

D. WILKES, Univ. of Massachusetts, Water Resources Research Ctr.

Death Valley

- 3.0180 TECTONIC ANALYSIS OF SEISMICALLY ACTIVE ZONES IN NEVADA, IN SUPPORT OF EARTHQUAKE CONTROL EXPERIMENT - CALIFORNIA, NEVADA, UTAH

P.P. ORKILD, U.S. Dept. of the Interior, Geological Survey

Delaware

- 6.0336 THE POLITICAL ECONOMY OF WATER RESOURCES

D.J. ALLEE, State University of New York, Agricultural Experiment Sta.

- 8.0002 COASTAL STORM DAMAGE WITH SPECIAL REFERENCE TO THE DELMARVA REGION OF DELAWARE, MARYLAND, VIRGINIA

F.J. SWAYE, Univ. of Delaware, School of Arts

- 15.0010 BEACH EROSION PROJECT, DELAWARE COAST PROTECTION PROJECT, DELAWARE

UNKNOWN, U.S. Army, Engineer District

SUSSEX COUNTY

- 8.0002 COASTAL STORM DAMAGE WITH SPECIAL REFERENCE TO THE DELMARVA REGION OF DELAWARE, MARYLAND, VIRGINIA

F.J. SWAYE, Univ. of Delaware, School of Arts

Delaware Basin

- 6.0130 REGIONAL COMPREHENSIVE MULTI-PURPOSE WATER RESOURCES PLANNING STUDIES IN NEW YORK

J.A. FINCK, State Dept. of Env. Conserv.

Delaware Bay

- 8.0002 COASTAL STORM DAMAGE WITH SPECIAL REFERENCE TO THE DELMARVA REGION OF DELAWARE, MARYLAND, VIRGINIA

F.J. SWAYE, Univ. of Delaware, School of Arts

Edwards Plateau

- 6.0388 RELATION OF CLIMATIC AND WATERSHED CHARACTERISTICS TO STORM RUNOFF IN THE EDWARDS PLATEAU - TEXAS
 W.G. KNISSEL, U.S. Dept. of Agriculture, Blackland Experiment Watershed

Everglades National Park

- 10.0028 SUBSIDENCE INVESTIGATIONS ON ORGANIC SOILS
 B.G. VOLK, Agric. Res. & Educ. Center

Finger Lakes

- 6.0340 DRAINAGE STUDY - INVENTORY AND ANALYSIS
 UNKNOWN, Genesee Finger Lake Reg. Board

Flat River

- 3.0240 RESEARCH IN EARTH STRAINS AND FOCAL MECHANISMS - MISSOURI
 W. STAUDER, St. Louis University, School of Arts

Florida

- 2.0003 CENTRAL FLORIDA SEEDING PROJECT
 J.D. MCFADDEN, U.S. Dept. of Commerce, Research Flight Facility
 2.0005 JOINT FEDERAL-STATE CUMULUS SEEDING PROGRAM FOR MITIGATION OF 1971 SOUTH FLORIDA DROUGHT
 J. SIMPSON, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.
 2.0010 FLORIDA CUMULUS SEEDING EXPERIMENT FOR DROUGHT MITIGATION, APRIL-MAY 1971
 W.L. WOODLEY, U.S. Dept. of Commerce, Environmental Research Laboratories
 2.0014 BEACHES AND GROUND WATER OF CAPE SABLE, FLORIDA, DURING EXTREME DROUGHT
 R.J. RUSSELL, Louisiana State Univ. Systems, Coastal Studies Institute
 6.0005 FLOOD INSURANCE STUDY
 C. BARRIENTOS, U.S. Dept. of Commerce, National Weather Service
 6.0066 AN OPTIMUM WATER ALLOCATION MODEL BASED ON AN ANALYSIS FOR THE KISSIMMEE RIVER BASIN - FLORIDA
 J.E. REYNOLDS, Univ. of Florida, School of Agriculture
 6.0067 HYDROLOGIC AND BIOLOGIC STUDIES OF SOUTHWEST FLORIDA (BIG CYPRESS)
 H. KLEIN, U.S. Dept. of the Interior, Geological Survey
 6.0068 RESPONSE OF WATER LEVELS TO FLOOD CONTROL OPERATIONS IN SOUTHEASTERN FLORIDA
 W.A. PITT, U.S. Dept. of the Interior, Geological Survey
 6.0069 HYDROLOGIC BASE FOR WATER MANAGEMENT, DADE COUNTY, FLORIDA
 UNKNOWN, U.S. Dept. of the Interior, Geological Survey
 6.0070 STUDIES OF THE RED ALGAE IN BISCAYNE BAY
 A. THORHAUG, Univ. of Miami, School of Marine Science
 6.0071 ESTUARINE HYDROLOGY OF TAMPA BAY
 C.R. GOODWIN, U.S. Dept. of the Interior, Geological Survey
 6.0072 ORANGE, SEMINOLE, OSCEOLA COUNTIES WATER MANAGEMENT
 UNKNOWN, East Cent. Florida Reg. Coun.
 6.0230 GEOHYDROLOGIC CONDITIONS AND FLOOD POTENTIALS IN THE SINK AREAS OF SOUTHWESTERN SEMINOLE COUNTY, FLORIDA
 W. ANDERSON, U.S. Dept. of the Interior, Geological Survey
 6.0231 SARASOTA - ZONING AND SUBDIVISION CONTROLS - REVIEW, ANALYSIS, AND RECOMMENDATIONS CONCERNING CURRENT REGULATIONS
 E.R. BARTLEY, Tampa Bay Regional Plan. Coun.
 6.0232 ZONING REGULATIONS OF THE CITY OF SARASOTA, FLORIDA
 UNKNOWN, Tampa Bay Regional Plan. Coun.

- ON SMALL DRAINAGE AREAS IN FLORIDA
W.C. BRIDGES, U.S. Dept. of the Interior, Geological Survey
- 6.0234 HYDROGRAPH MODEL STUDIES OF THE HILLSBOROUGH, ALAFIA, AND ANCLOTE RIVER BASINS, FLORIDA
J.F. TURNER, U.S. Dept. of the Interior, Geological Survey
- 6.0235 FLOOD PLAIN STUDY AND MODEL FLOOD PLAIN ORDINANCE
UNKNOWN, Palm Beach Co. Area Plan. Bd.
- 6.0236 FLOOD PLAIN STUDY AND MODEL FLOOD PLAIN ORDINANCE, MARCH, 1972
UNKNOWN, Palm Beach Co. Area Plan. Bd.
- 8.0005 ATLANTIC HURRICANE SEASON OF 1972
R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service
- 8.0026 EVACUATION OF COASTAL RESIDENTS DURING HURRICANES A PILOT STUDY FOR DADE COUNTY, FLORIDA
UNKNOWN, Miami Federal Executive Board
- 8.0103 BEACH CHANGES BY EXTRAORDINARY WAVES CAUSED BY HURRICANE CAMILLE
C.J. SONU, Louisiana State Univ. Systems, Coastal Studies Institute
- 8.0123 PRELIMINARY CLIMATIC DATA REPORT HURRICANE AGNES JUNE 14-23, 1972
R.M. DEANGELIS, U.S. Dept. of Commerce, Natl. Climatic Center
- 10.0028 SUBSIDENCE INVESTIGATIONS ON ORGANIC SOILS
B.G. VOLK, Agric. Res. & Educ. Center
- 10.0029 REMOTE SENSING, ALAFIA AND PEACE RIVER BASINS, FLORIDA
A.E. COKER, U.S. Dept. of the Interior, Geological Survey
- 12.0025 LIFE CYCLE OF FLORIDA KEYS' WATER-SPOUTS
J.H. GOLDEN, U.S. Dept. of Commerce, Environ. Research Laboratories
- 12.0039 SOME STATISTICAL ASPECTS OF WATER-SPOUT FORMATION - FLORIDA
J.H. GOLDEN, U.S. Dept. of Commerce, Natl. Severe Storms Lab.
- 15.0005 KENNEDY SPACE CENTER OCEAN BEACH EROSION - FLORIDA
A.J. MEHTA, Univ. of Florida, School of Engineering
- 15.0006 BAL. HARBOUR, FLORIDA PARTIAL BEACH RESTORATION, BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT, DADE COUNTY, FLORIDA
UNKNOWN, U.S. Army, Engineer District
- 15.0015 COASTAL WORKS EVALUATION - CALIFORNIA, FLORIDA
UNKNOWN, U.S. Army, Coastal Engin. Res. Center
- 15.0016 COASTAL ENGINEERING STUDIES RELATED TO FLORIDA'S SHORELINE AND BEACH EROSION PROBLEMS
J.A. PURPURA, Univ. of Florida, School of Engineering
- 15.0017 A STUDY OF NEARSHORE PROCESSES IN

- 6.0068 RESPONSE OF WATER LEVELS TO FLOOD CONTROL OPERATIONS IN SOUTHEASTERN FLORIDA
W.A. PITT, U.S. Dept. of the Interior, Geological Survey

DADE COUNTY

- 6.0068 RESPONSE OF WATER LEVELS TO FLOOD CONTROL OPERATIONS IN SOUTHEASTERN FLORIDA
W.A. PITT, U.S. Dept. of the Interior, Geological Survey
- 6.0069 HYDROLOGIC BASE FOR WATER MANAGEMENT, DADE COUNTY, FLORIDA
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 8.0026 EVACUATION OF COASTAL RESIDENTS DURING HURRICANES A PILOT STUDY FOR DADE COUNTY, FLORIDA
UNKNOWN, Miami Federal Executive Board
- 15.0006 BAL. HARBOUR, FLORIDA PARTIAL BEACH RESTORATION, BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT, DADE COUNTY, FLORIDA
UNKNOWN, U.S. Army, Engineer District

FT. WALTON

- 8.0103 BEACH CHANGES BY EXTRAORDINARY WAVES CAUSED BY HURRICANE CAMILLE
C.J. SONU, Louisiana State Univ. Systems, Coastal Studies Institute

ORANGE COUNTY

- 6.0072 ORANGE, SEMINOLE, OSCEOLA COUNTIES - WATER MANAGEMENT
UNKNOWN, East Cent. Florida Reg. Comm.

OSCEOLA COUNTY

- 6.0072 ORANGE, SEMINOLE, OSCEOLA COUNTIES - WATER MANAGEMENT
UNKNOWN, East Cent. Florida Reg. Comm.

PALM BEACH COUNTY

- 6.0235 FLOOD PLAIN STUDY AND MODEL FLOOD PLAIN ORDINANCE
UNKNOWN, Palm Beach Co. Area Plan. Bd.
- 6.0236 FLOOD PLAIN STUDY AND MODEL FLOOD PLAIN ORDINANCE, MARCH, 1972
UNKNOWN, Palm Beach Co. Area Plan. Bd.

SARASOTA

- 6.0231 SARASOTA - ZONING AND SUBDIVISION CONTROLS - REVIEW, ANALYSIS, AND RECOMMENDATIONS

- 6.0072 ORANGE, SEMINOLE, OSCEOLA COUNTIES -
WATER MANAGEMENT
UNKNOWN, East Cent. Florida Reg. Comm.
- 6.0230 GEOHYDROLOGIC CONDITIONS AND FLOOD
POTENTIALS IN THE SINK AREAS OF SOUTH
WESTERN SEMINOLE COUNTY, FLORIDA
W. ANDERSON, U.S. Dept. of the Interior, Geological Survey

Front Range

- 1.0012 PHYSICAL PROPERTIES OF ALPINE SNOW AS
RELATED TO WEATHER AND AVALANCHE CON-
DITIONS
M. MARTINELLI, U.S. Dept. of Agriculture, Rocky Mtn.
For. & Rg. Ex. Sta.
- 4.0005 DENVER URBAN CORRIDOR STUDIES -
COLORADO
W.R. HANSEN, U.S. Dept. of the Interior, Geological Survey
- 6.0185 MOUNTAIN SOILS, FRONT RANGE URBAN
CORRIDOR
K.L. PIERCE, U.S. Dept. of the Interior, Geological Survey
- 9.0044 DENVER-FRONT RANGE URBAN CORRIDOR
T.W. OFFIELD, U.S. Dept. of the Interior, Geological Survey

Galveston Bay

- 8.0013 TEXAS COAST HURRICANE SURGE MODEL
STUDIES
N.J. BROGDON, U.S. Army, Estuaries Division
- 8.0039 GALVESTON BAY HURRICANE SURGE - RE-
PORT 3 - EFFECTS OF BARRIERS ON TIDES, CUR-
RENTS, SALINITIES, AND DYE DISPERSION (AB-
BREV)
W.H. BOHB, U.S. Army, Waterways Experiment Station
- 8.0040 GALVESTON BAY HURRICANE SURGE STUDY
- BARRIERS ON HURRICANE SURGE HEIGHTS -
HYDRAULIC MODEL INVESTIGATION
N.J. BROGDON, U.S. Army, Waterways Experiment Station
- 8.0045 GALVESTON BAY HURRICANE SURGE - RE-
PORT 1 - EFFECTS OF PROPOSED BARRIERS ON
HURRICANE SURGE HEIGHTS (ABBREV)
R.A. SAGER, U.S. Army, Waterways Experiment Station
- 8.0046 GALVESTON BAY HURRICANE SURGE - RE-
PORT (2) EFFECTS OF PROPOSED BARRIERS ON
TIDES, CURRENTS, SALINITIES, AND DYE DISPER-
SION (ABBREV)
R.A. SAGER, U.S. Army, Waterways Experiment Station

Garlock Fault

- 3.0111 SAN ANDREAS FAULT - CALIFORNIA COOP
M.M. CLARK, U.S. Dept. of the Interior, Geological Survey

- 5.0043 THE INFLUENCE OF WEATHER AND CLIMATE
ON FOREST FIRE OCCURRENCE AND BEHAVIOR
IN THE EAST AND SOUTH
D.T. WILLIAMS, U.S. Dept. of Agriculture, S.E. Forest Ex-
periment Station
- 6.0033 SPEWRELI BLUFF LAKE, FLINT RIVER, GEOR-
GIA
UNKNOWN, U.S. Army, Engineer District
- 6.0073 CASE STUDY OF REMEDIAL FLOOD MANAGE-
MENT IN AN URBAN AREA - PHASE III
L.D. JAMES, Georgia Inst. of Technology, Environmental
Resources Center
- 6.0074 CRITICAL ANALYSIS OF FIVE WATERSHED
MODELS IN FOUR PHYSIOGRAPHIC REGIONS OF
GEORGIA
A.M. LUMB, Georgia Inst. of Technology, Environmental
Resources Center
- 6.0075 FLOOD HYDROLOGY ON SMALL DRAINAGE
AREAS IN GEORGIA
H.G. GOLDEN, U.S. Dept. of the Interior, Geological Survey
- 6.0237 IMPLICATIONS OF ZONING AS AN URBAN
WATER MANAGEMENT MEASURE - GEORGIA
C.F. FLOYD, Univ. of Georgia, School of Business Admin.
- 6.0240 THE PEACHTREE CREEK WATERSHED AS A
CASE HISTORY IN URBAN FLOOD PLAIN
DEVELOPMENT
L.D. JAMES, Georgia Inst. of Technology, Environmental
Resources Center
- 6.0241 TRAVEL TIME OF GEORGIA STREAMS
A.M. LUMB, Georgia Inst. of Technology, Environmental
Resources Center
- 6.0242 THE EFFECTS OF LAND USE CHANGE ON THE
HYDROLOGY OF AN URBAN WATERSHED
J.R. WALLACE, Georgia Inst. of Technology, Environmental
Resources Center
- 6.0244 ATLANTA METROPOLITAN AREA URBAN
FLOOD RUNOFF CHARACTERISTICS - GEORGIA
H.G. GOLDEN, U.S. Dept. of the Interior, Geological Survey
- 6.0245 WATER RESOURCES OF MIDDLE GEORGIA
UNKNOWN, Middle Georgia Area Plan. Comm.
- 15.0007 JEKYLL ISLAND, GEORGIA, BEACH EROSION
CONTROL AND HURRICANE PROTECTION
UNKNOWN, U.S. Army, Engineer District

ATLANTA

- 6.0240 THE PEACHTREE CREEK WATERSHED AS A
CASE HISTORY IN URBAN FLOOD PLAIN
DEVELOPMENT
L.D. JAMES, Georgia Inst. of Technology, Environmental
Resources Center
- 6.0242 THE EFFECTS OF LAND USE CHANGE ON THE
HYDROLOGY OF AN URBAN WATERSHED
J.R. WALLACE, Georgia Inst. of Technology, Environmental
Resources Center
- 6.0244 ATLANTA METROPOLITAN AREA URBAN
FLOOD RUNOFF CHARACTERISTICS - GEORGIA
H.G. GOLDEN, U.S. Dept. of the Interior, Geological Survey

Grand Isle

- 8.0030 GRAND ISLE, LOUISIANA, AND VICINITY HURRICANE PROTECTION ASSOCIATED WATER FEATURE, BAYOU LAFOURCHE - LOUISIANA (AB-BREV)

UNKNOWN, U.S. Army, Engineer District

Grand Traverse Bay

- 15.0026 COASTAL ZONE AND SHORELANDS MANAGEMENT - GREAT LAKES

J.M. ARMSTRONG, Univ. of Michigan, School of Engineering

Great Basin

- 3.0180 TECTONIC ANALYSIS OF SEISMICALLY ACTIVE ZONES IN NEVADA, IN SUPPORT OF EARTHQUAKE CONTROL EXPERIMENT - CALIFORNIA, NEVADA, UTAH

P.P. ORKILD, U.S. Dept. of the Interior, Geological Survey

- 3.0180 TECTONIC ANALYSIS OF SEISMICALLY ACTIVE ZONES IN NEVADA, IN SUPPORT OF EARTHQUAKE CONTROL EXPERIMENT - CALIFORNIA, NEVADA, UTAH

P.P. ORKILD, U.S. Dept. of the Interior, Geological Survey

- 3.0258 MICROSEISMICITY AND TECTONICS OF THE NEVADA SEISMIC ZONE

F.J. GUMPER, Columbia University, Lamont Doherty Geolog. Observ.

Great Lakes

- 6.0052 REGULATION OF GREAT LAKES WATER LEVELS REPORT TO THE INTERNATIONAL JOINT COMMISSION BY THE INTERNATIONAL GREAT LAKES LEVELS BOARD

UNKNOWN, Internat. Joint Commission

- 6.0207 LAKE HYDROLOGY

L. BAJORUNAS, U.S. Dept. of Commerce, Limnology Division

- 6.0267 HYDROLOGIC MODELS OF THE GREAT LAKES

D.D. MEREDITH, Univ. of Illinois, School of Engineering

- 11.0003 THE MODIFICATION OF GREAT LAKES WINTER STORMS

H.K. IVECKMANN, U.S. Dept. of Commerce, Atmospheric Phys. & Chem. Lab.

- 11.0005 SNOW FORECASTING FOR SOUTHEASTERN WISCONSIN

R.W. HARMS, U.S. Dept. of Commerce, Natl. Weather Service

J.M. ARMSTRONG, Univ. of Michigan, School of Engineering

- 16.0040 REGULATION OF GREAT LAKES WATER LEVELS - A SUMMARY REPORT/1974
UNKNOWN, Internat. Joint Commission

Gulf of Alaska

- 3.0131 TECTONIC HISTORY - NORTH PACIFIC CONTINENTAL MARGIN - ALASKA

R. VONHUENE, U.S. Dept. of the Interior, Geological Survey

- 13.0012 EVALUATION OF LONG PERIOD SURFACE WAVES IN THE GULF OF ALASKA

T.C. ROYER, Univ. of Alaska, Inst. of Marine Sciences

Gulf of Mexico

- 8.0006 APPLICATION OF ECONOMIC ANALYSES TO HURRICANE WARNINGS TO RESIDENTIAL AND RETAIL ACTIVITIES IN THE U. S. GULF OF MEXICO COASTAL REGION

L.G. ANDERSON, Univ. of Miami, School of Marine Science

- 8.0040 GALVESTON BAY HURRICANE SURGE STUDY - BARRIERS ON HURRICANE SURGE HEIGHTS - HYDRAULIC MODEL INVESTIGATION

N.J. BROGDON, U.S. Army, Waterways Experiment Station

- 8.0048 EFFECTS ON LAKE PONCHARTRAIN, LA., OF HURRICANE SURGE CONTROL STRUCTURES AND MISSISSIPPI RIVER-GULF OUTLET CHANNEL

I.C. TALJANT, U.S. Army, Waterways Experiment Station

- 8.0049 THE USE OF GRASSES FOR DUNE STABILIZATION ALONG THE GULF COAST WITH INITIAL EMPHASIS ON THE TEXAS COAST

T.W. BILHORN, Gulf Univ. Res. Consortium

- 8.0051 PRELIMINARY REPORT ON AN ANALYSIS OF PROJECT II DATA (WAVE FORCES ON A PILE), HURRICANE CARLA, GULF OF MEXICO

F.M. ABDELAAL, Univ. of California, School of Engineering

- 8.0076 HURRICANE EFFECTS ON PORT FACILITIES

R.D. MARSHALL, U.S. Dept. of Commerce, Natl. Bureau of Standards

- 8.0086 COMPUTER METHODS APPLIED TO ATLANTIC AREA TROPICAL STORM AND HURRICANE CLIMATOLOGY

J.R. HOPE, U.S. Dept. of Commerce, Natl. Weather Service

- 8.0106 BENEFITS OF ENVIRONMENTAL PREDICTION IN THE EASTERN GULF OF MEXICO

M.G. JOHNSON, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

- 8.0107 HURRICANE MODIFICATION RESEARCH (PROJECT STORMFURY)

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

- 8.0109 TROPICAL STORM SURGE FORECASTING

- C.P. JELENSKI, U.S. Dept. of Commerce, Techniques Development Lab
- 8.0122 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES (FOR SELECTED STATIONS AND THE MONTH OF SEPTEMBER)
H.I. CRUTCHER, U.S. Dept. of Commerce, Natl. Climatic Center
- 8.0132 ATLANTIC HURRICANE FREQUENCIES ALONG THE U.S. COASTLINE
R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service
- 15.0035 PROPERTIES AND STABILITY OF A TEXAS BARRIER BEACH INLET
C. MASON, Texas A & M University System, Graduate School
- 15.0036 INVESTIGATION OF SHORELINE CHANGES AT SARGENT BEACH, TEXAS
W.N. SEELIG, Texas A & M University System, Graduate School
- 15.0037 TEXAS BARRIER ISLANDS
R.E. HUNTER, U.S. Dept. of the Interior, Geological Survey

Gulf Coastal Plain

- 3.0243 THE EFFECT OF GEOLOGIC STRUCTURE ON THE OCCURRENCE OF FRESH GROUND WATER IN POST-OLIGOCENE DEPOSITS OF THE GULF COASTAL PLAIN
P.H. JONES, U.S. Dept. of the Interior, Geological Survey
- 6.0067 HYDROLOGIC AND BIOLOGIC STUDIES OF SOUTHWEST FLORIDA (BIG CYPRESS)
H. KLEIN, U.S. Dept. of the Interior, Geological Survey
- 10.0008 STATUS OF LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL IN MISSISSIPPI
D.M. KEADY, Mississippi St. University, School of Arts
- 10.0032 CONTROL OF LAND SUBSIDENCE IN THE TEXAS GULF COAST AREA
A.P. DELFLACHE, Lamar University, School of Engineering

Hawaii

- 6.0076 URBAN HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII
Y. FOK, Univ. of Hawaii, Water Resources Research Ctr.
- 6.0077 FLOOD HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII
Y.S. FOK, Univ. of Hawaii, Water Resources Research Ctr.
- 6.0078 INSTANTANEOUS UNIT HYDROGRAPH ANALYSIS OF HAWAIIAN SMALL WATERSHEDS
R. IVANG, Univ. of Hawaii, Water Resources Research Ctr.
- 6.0246 SPACE-TIME VARIATIONS IN HIGH INTENSITY RAINFALL ON THE WINDWARD COAST OF THE ISLAND OF HAWAII (PHASE III)
C.M. FULLERTON, Univ. of Hawaii, Cloud Physics Observatory
- 6.0247 HYDROLOGIC RELATIONS IN HAWAII
D. JAY, U.S. Army, Pacific Ocean Division
- 6.0249 SPECIAL FLOOD DATA COLLECTION, HAWAII

- R.H. NAKAHARA, U.S. Dept. of the Interior, Geological Survey
- 6.0251 SPECIAL FLOOD DATA COLLECTION - HAWAII
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0252 HAWAII ENVIRONMENTAL SIMULATION MODEL
D.C. COX, Univ. of Hawaii, School of Arts
- 8.0097 GIANT WAVES HIT HAWAII
J. BOTTOMS, U.S. Dept. of Commerce, Natl. Weather Service
- 13.0009 STABILITY OF RUBBLE-MOUND TSUNAMI BARRIER HILO HARBOR, HAWAII. HYDRAULIC MODEL INVESTIGATION
A.M. KAMEL, U.S. Army, Waterways Experiment Station
- 13.0010 STEADY-FLOW STABILITY TESTS OF NAVIGATION OPENING STRUCTURES, HILO HARBOR, TSUNAMI BARRIER, HILO, HAWAII. HYDRAULIC MODEL INVESTIGATION
N.R. OSWALT, U.S. Army, Waterways Experiment Station
- 13.0024 TSUNAMI SHORELINE TRACK
G.P. WOOLLARD, Univ. of Hawaii, Hawaii Inst. of Geophysics
- 13.0025 THE MAJOR TSUNAMI IN THE HAWAIIAN ISLANDS
UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey
- 13.0027 A REVIEW OF THE EXPERIMENTAL DATA RELATIVE TO THE PILOT MODEL STUDY FOR THE DESIGN OF HILO HARBOR TSUNAMI MODEL
G.H. KEULEGAN, U.S. Army, Waterways Experiment Station
- 14.0001 VOLCANIC HAZARDS ON THE ISLANDS OF HAWAII
D.R. MULLINEAUX, U.S. Dept. of the Interior, Geological Survey
- 14.0004 HAWAIIAN VOLCANO OBSERVATORY
D.W. PETERSON, U.S. Dept. of the Interior, Geological Survey
- 14.0008 THERMAL SURVEILLANCE OF VOLCANOES - REMOTE SENSING OF LONG VALLEY IN GEOTHERMAL PROGRAM - WASHINGTON, OREGON AND CALIFORNIA
J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey
- 14.0010 VOLCANIC HAZARDS, ISLAND OF HAWAII
D.R. MULLINEAUX, U.S. Dept. of the Interior, Geological Survey
- 14.0014 REGIONAL VOLCANOLOGY - WESTERN UNITED STATES INCLUDING ALASKA AND HAWAII
R.L. SMITH, U.S. Dept. of the Interior, Geological Survey
- 14.0015 RAINWATER CONTAMINATION BY VOLCANIC VOLATILES FROM KILAUEA VOLCANO, HAWAII (PHASE I)
J.B. FINLAYSON, Univ. of Hawaii, Water Resources Research Ctr.
- 15.0018 DEPOSITION OF HAWAIIAN WATERSHED AND ESTUARINE SEDIMENTS
P. FAN, Univ. of Hawaii, Water Resources Research Ctr.
- 15.0026 COASTAL ZONE AND SHORELANDS MANAGEMENT - GREAT LAKES

MODEL INVESTIGATION
N.R. OSWALT, U.S. Army, Waterways Experiment Station
13.0025 THE MAJOR TSUNAMI IN THE HAWAIIAN ISLANDS
UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey

HONOLULU

13.0025 THE MAJOR TSUNAMI IN THE HAWAIIAN ISLANDS
UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey
15.0018 DEPOSITION OF HAWAIIAN WATERSHED AND ESTUARINE SEDIMENTS
P. FAN, Univ. of Hawaii, Water Resources Research Ctr.

Kaunaloa

13.0025 THE MAJOR TSUNAMI IN THE HAWAIIAN ISLANDS
UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey

Hebgen Lake

3.0275 SEISMICITY AND CONTEMPORARY TECTONICS OF THE YELLOWSTONE PARK-HEBGEN LAKE REGION
R.B. SMITH, Univ. of Utah, School of Mines

Hillsborough River

6.0234 HYDROGRAPH MODEL STUDIES OF THE HILLSBOROUGH, ALABAMA, AND ANCLOTE RIVER BASINS, FLORIDA
J.F. TURNER, U.S. Dept. of the Interior, Geological Survey

Hilo Bay

13.0009 STABILITY OF RUBBLE-MOUND TSUNAMI BARRIER HILO HARBOR, HAWAII. HYDRAULIC MODEL INVESTIGATION
A.M. KAMEL, U.S. Army, Waterways Experiment Station
13.0010 STEADY-FLOW STABILITY TESTS OF NAVIGATION OPENING STRUCTURES, HILO HARBOR, TSUNAMI BARRIER, HILO, HAWAII - HYDRAULIC MODEL INVESTIGATION
N.R. OSWALT, U.S. Army, Waterways Experiment Station
13.0025 THE MAJOR TSUNAMI IN THE HAWAIIAN ISLANDS
UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey
13.0027 A REVIEW OF THE EXPERIMENTAL DATA RELATIVE TO THE PILOT MODEL STUDY FOR THE DESIGN OF HILO HARBOR TSUNAMI MODEL
G.H. KEULEGAN, U.S. Army, Waterways Experiment Station

Housatonic River

6.0118 ANSONIA-DERBY LOCAL PROTECTION PROJECT, NAUGATUCK AND HOUSATONIC RIVERS, CONNECTICUT - HYDRAULIC MODEL INVESTIGATION
G.A. PICKERING, U.S. Army, Waterways Experiment Station

Hurricane Creek

6.0055 HURRICANE CREEK WATERSHED PROJECT, HUMPHREYS AND DICKSON COUNTIES, TENNESSEE
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
6.0200 HURRICANE CREEK WATERSHED STRUCTURAL PROJECT MEASURE, KENTUCKY
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

Hurricane Fault

3.0276 REGIONAL SEISMICITY AND TECTONICS OF THE SOUTHERN INTERMOUNTAIN SEISMIC BELT WITH EMPHASIS ON THE WASATCH FRONT - UTAH
S.H. WARD, Univ. of Utah, School of Mines

Idaho

3.0050 TETON DAM SEISMICITY - IDAHO
W.V. MICKY, U.S. Dept. of the Interior, Geological Survey
3.0178 SNAKE RIVER PLAIN, PART A - REGIONAL TECTONICS - IDAHO
S.S. ORIEL, U.S. Dept. of the Interior, Geological Survey
3.0184 HAMILTON 2 DEGREE
J.D. WELLS, U.S. Dept. of the Interior, Geological Survey
6.0003 SILVER VALLEY FLOOD - SOCIAL PSYCHOLOGICAL EFFECTS
C.D. HARVEY, Boise State College, School of Arts
6.0063 FLOOD CHARACTERISTICS OF SMALL DRAINAGE AREAS, IDAHO
C.A. THOMAS, U.S. Dept. of the Interior, Geological Survey
6.0079 FLOOD INVESTIGATIONS FOR SMALL AREAS - IDAHO
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
6.0080 A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS - REPORT ON FLOOD CONTROL SUBPROJECT - IDAHO
J.J. PEEBLES, Univ. of Idaho, Water Resources Research Inst.

- 6.0253 NATURAL GASFLOW THROUGH PART OF
COUNTY, IDAHO, JUNE 1973
H.W. LEE, State Planning & Com. Aff. Agcy
- 6.0254 MAGNITUDE AND FREQUENCY OF FLOODS IN
SMALL DRAINAGE BASINS IN IDAHO
C.A. THOMAS, U.S. Dept. of the Interior, Geological Survey
- 9.0046 SNAKE RIVER BASIN, PART F - SOUTHERN
PART, NORTHWEST MARGIN - IDAHO
B. SKIPP, U.S. Dept. of the Interior, Geological Survey
- 12.0030 ESTIMATE OF MAXIMUM WIND SPEEDS OF
TORNADOES IN THREE NORTHWESTERN STATES -
IDAHO, OREGON, WASHINGTON
T.T. FUJITA, Univ. of Chicago, School of Physical Sciences
- 14.0011 EASTERN SNAKE RIVER PLAIN REGION IN-
VESTIGATIONS - IDAHO
S.S. ORIEL, U.S. Dept. of the Interior, Geological Survey
- 14.0012 SNAKE RIVER PLAIN, PART E - NORTH CEN-
TRAL - IDAHO
D. SCHLEICHER, U.S. Dept. of the Interior, Geological Sur-
vey
- 14.0013 SNAKE RIVER PLAIN, PART B - VOLCANIC
ROCKS - IDAHO
P.L. WILLIAMS, U.S. Dept. of the Interior, Geological Sur-
vey

SIOUXONE COUNTY

- 6.0003 SILVER VALLEY FLOOD - SOCIAL
PSYCHOLOGICAL EFFECTS
C.D. HARVEY, Boise State College, School of Arts

Illinois

- 2.0011 DROUGHT CLIMATOLOGY OF ILLINOIS
F.A. HUFF, State Water Survey
- 2.0012 POTENTIAL OF PRECIPITATION MODIFICA-
TION IN MODERATE TO SEVERE DROUGHTS
F.A. HUFF, State Water Survey
- 3.0174 NEW MADRID EARTHQUAKE - ARKANSAS, IL-
LINOIS, KENTUCKY, MISSISSIPPI, MISSOURI AND
TENNESSEE
M.F. KANE, U.S. Dept. of the Interior, Geological Survey
- 3.0241 SEISMIC STUDIES - SOUTH CENTRAL ILLINOIS
EARTHQUAKE OF NOVEMBER 9, 1968
W. STAUDER, St. Louis University, School of Engineering
- 5.0009 EMPLOYMENT OF AIR OPERATIONS IN THE
FIRE SERVICES - PROCEEDINGS OF A SYMPOSIUM,
HELD AT ARGONNE NATIONAL LABORATORY
(ABBREV)
UNKNOWN, Natl. Acad. of Sciences
- 6.0058 FLOOD FLOWS FROM SMALL DRAINAGE
AREAS
J.D. CAMP, U.S. Dept. of the Interior, Geological Survey
- 6.0082 FLOOD FLOWS FROM SMALL DRAINAGE
BASINS IN ILLINOIS
G.W. CURTIS, U.S. Dept. of the Interior, Geological Survey
- 6.0083 DEVELOPMENT OF A FLOOD AND POLLUTION
CONTROL PLAN FOR THE CHICAGO AND AREA
- 6.0086 OAKLEY-SANGAMON REMOTE SENSING EN-
VIRONMENTAL RESEARCH PROGRAM - ILLINOIS
H.M. KARARA, Univ. of Illinois, School of Engineering
- 6.0199 NUTWOOD WATERSHED, ILLINOIS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service
- 6.0255 DEPTH AND FREQUENCY OF FLOODS IN IL-
LINOIS
J.D. CAMP, U.S. Dept. of the Interior, Geological Survey
- 6.0256 FLOOD FREQUENCY STUDY ILLINOIS
J.M. CARNS, U.S. Dept. of the Interior, Geological Survey
- 6.0258 NATURAL CAPABILITIES - THE FRIENDS
CREEK SERIES, MACON COUNTY, ILLINOIS
UNKNOWN, Macon Co. Regional Plan Comm.
- 6.0260 A COMPREHENSIVE PLAN FOR STEPHENSON
COUNTY, ILLINOIS
UNKNOWN, Stephenson Co. Planning Comm.
- 6.0261 FLOOD INUNDATION MAPPING, NORTHEAST-
ERN ILLINOIS
A.W. NOELKE, U.S. Dept. of the Interior, Geological Survey
- 6.0262 PRIORITY AND PLANNING ELEMENTS FOR
DEVELOPING ILLINOIS WATER RESOURCES
UNKNOWN, State Dept. of Bus. & Dev.
- 6.0263 STREAMFLOW VARIABILITY - ILLINOIS
K.P. SINGH, State Water Survey
- 6.0264 EVALUATION OF FLOOD RISKS
V.T. CHOI, Univ. of Illinois, School of Engineering
- 6.0265 RUNOFF FROM SMALL AGRICULTURAL
AREAS IN ILLINOIS
B.A. JONES, Univ. of Illinois, Agricultural Experiment Sta.
- 6.0266 AN APPRAISAL OF FLOODPLAIN REGULA-
TIONS IN THE STATES OF ILLINOIS, INDIANA,
IOWA, MISSOURI AND OHIO
W.M. KETTL, Univ. of Illinois, Water Resources Center
- 7.0008 STUDIES OF HAIL DATA IN 1970-72 - ILLINOIS
S.A. CHANGNON, State Water Survey
- 7.0015 DESIGN OF HAIL SUPPRESSION EXPERIMENT
IN ILLINOIS
G.M. MORGAN, Univ. of Illinois, School of Liberal Arts
- 9.0011 ENGINEERING GEOLOGY - ILLINOIS
W.C. SMITH, State Geol. Survey
- 12.0017 DENSE RAIN GAGE NETWORK PROJECTS - IL-
LINOIS
S.A. CHANGNON, State Water Survey
- 12.0032 STUDY OF URBAN EFFECTS ON PRECIPITA-
TION AND SEVERE WEATHER AT ST. LOUIS - IL-
LINOIS
S.A. CHANGNON, State Water Survey
- 12.0033 HYDROMETEOROLOGICAL ANALYSIS OF
SEVERE RAINSTORMS - ILLINOIS
F.A. HUFF, State Water Survey
- 12.0034 STUDY OF THE SYNOPTIC CLIMATOLOGY OF
NORTH AMERICA
G. MORGAN, State Water Survey

- 5.0009 EMPLOYMENT OF AIR OPERATIONS IN THE FIRE SERVICES - PROCEEDINGS OF A SYMPOSIUM, HELD AT ARGONNE NATIONAL LABORATORY (ABBREV)
UNKNOWN, Natl. Acad. of Sciences

- 6.0083 DEVELOPMENT OF A FLOOD AND POLLUTION CONTROL PLAN FOR THE CHICAGOLAND AREA - COMPUTER SIMULATION PROGRAMS
D.H. CHURCHILL, Illinois Inst. For Envir. Oity

FREEPORT

- 6.0260 A COMPREHENSIVE PLAN FOR STEPHENSON COUNTY, ILLINOIS
UNKNOWN, Stephenson Co. Planning Comm.

GREENE COUNTY

- 6.0199 NUTWOOD WATERSHED, ILLINOIS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

JERSEY COUNTY

- 6.0199 NUTWOOD WATERSHED, ILLINOIS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

MACON COUNTY

- 6.0258 NATURAL CAPABILITIES - THE FRIENDS CREEK SERIES, MACON COUNTY, ILLINOIS
UNKNOWN, Macon Co. Regional Plan Comm.

MADISON COUNTY

- 6.0084 BACKGROUND SURVEY - SURFACE DRAINAGE PROGRAM, MADISON, ST. CLAIR, MONROE AND RANDOLPH COUNTIES, ILLINOIS
UNKNOWN, Southwestern Ill. Plan. Comm.

MONROE COUNTY

- 6.0084 BACKGROUND SURVEY - SURFACE DRAINAGE PROGRAM, MADISON, ST. CLAIR, MONROE AND RANDOLPH COUNTIES, ILLINOIS
UNKNOWN, Southwestern Ill. Plan. Comm.

RANDOLPH COUNTY

- 6.0084 BACKGROUND SURVEY - SURFACE DRAINAGE PROGRAM, MADISON, ST. CLAIR, MONROE AND RANDOLPH COUNTIES, ILLINOIS
UNKNOWN, Southwestern Ill. Plan. Comm.

STEPHENSON COUNTY

- 6.0260 A COMPREHENSIVE PLAN FOR STEPHENSON COUNTY, ILLINOIS
UNKNOWN, Stephenson Co. Planning Comm.

Imperial Valley

- 3.0100 RECONNAISSANCE STUDY OF RECOVERABLE GROUND WATER
L.C. DUTCHER, U.S. Dept. of the Interior, Geological Survey

Indiana

- 6.0087 DRAINAGE AND FLOOD CONTROL PLAN - MARION COUNTY, INDIANA SEPTEMBER 1970
UNKNOWN, Marion Co. Metrop. Dev. Dept.

- 6.0088 INITIAL RESULTS FROM THE UPPER WABASH SIMULATION MODEL
T.P. CHANG, Purdue University, Water Resources Research Ctr.

- 6.0208 HYDROLOGIC STUDY OF SMALL RURAL WATERSHEDS - INDIANA
COOK, U.S. Dept. of the Interior, Geological Survey

- 6.0266 AN APPRAISAL OF FLOODPLAIN REGULATIONS IN THE STATES OF ILLINOIS, INDIANA, IOWA, MISSOURI AND OHIO
W.M. KETH, Univ. of Illinois, Water Resources Center

- 6.0268 ZONING ORDINANCE - KNOX COUNTY, INDIANA
UNKNOWN, Clyde E. Williams & Assoc. Inc

- 6.0270 THE EFFECT OF URBANIZATION ON HYDROLOGY OF WATERSHEDS - INDIANA
J.W. DELLER, Purdue University, School of Engineering

- 6.0271 WABASH RIVER SYSTEMS MODELS FOR PROJECT MANAGEMENT, PLANNING AND EVALUATION
G.H. TOEBES, Purdue University, School of Civil Engin.

- 6.0312 MODEL STUDY OF CANNELTON LOCKS AND DAM, OHIO RIVER, INDIANA AND KENTUCKY
J.J. FRANCO, U.S. Army, Waterways Experiment Station

- 10.0009 DETECTION OF SUBSURFACE OPENINGS - INDIANA, MISSOURI
E.R. BATES, U.S. Army, Waterways Experiment Station

- 16.0082 CLIMATOLOGICAL ASSESSMENT OF URBAN EFFECTS ON PRECIPITATION - PART I
F.A. HUFF, State Water Survey

KNOX COUNTY

- 6.0268 ZONING ORDINANCE - KNOX COUNTY, INDIANA
UNKNOWN, Clyde E. Williams & Assoc. Inc

- 6.0270 THE EFFECT OF URBANIZATION ON
HYDROLOGY OF WATERSHEDS - INDIANA
J.W. DELLEUR, Purdue University, School of Engineering

Iowa

- 6.0018 URBAN GROWTH, RUNOFF, EXTERNALITIES,
AND INCOME DISTRIBUTION EFFECTS IN RAIL-
STON CREEK WATERSHEDS
J.R. BARNARD, Univ. of Iowa, School of Liberal Arts
- 6.0064 COLLECTION AND ANALYSIS OF STREAM
FLOW AND RELATED HYDRAULIC DATA FOR
DESIGN OF HIGHWAY BRIDGES AND CULVERTS -
IOWA
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0266 AN APPRAISAL OF FLOODPLAIN REGULA-
TIONS IN THE STATES OF ILLINOIS, INDIANA,
IOWA, MISSOURI AND OHIO
W.M. KEITH, Univ. of Illinois, Water Resources Center
- 6.0274 FLOOD PROFILES OF IOWA STREAMS
O.G. LARA, U.S. Dept. of the Interior, Geological Survey
- 6.0275 FLOOD PROFILES & FLOOD-PLAIN INFORMA-
TION, LINN COUNTY, IOWA
O.G. LARA, U.S. Dept. of the Interior, Geological Survey
- 6.0276 FLOOD PROFILES & FLOOD-PLAIN INFORMA-
TION, CEDAR RAPIDS, IOWA
O.G. LARA, U.S. Dept. of the Interior, Geological Survey
- 6.0277 FLOOD PROFILES AND FLOOD-PLAIN INFOR-
MATION FOR UNIVERSITY BRANCH, DRY RUN
CREEK, CEDAR FALLS, IOWA
O.G. LARA, U.S. Dept. of the Interior, Geological Survey
- 6.0278 FLOOD FREQUENCY, LOG-PEARSON TYPE III
ANALYSIS - IOWA
O.G. LARA, U.S. Dept. of the Interior, Geological Survey
- 6.0279 FLOOD PROFILES AND FLOOD-PLAIN INFOR-
MATION, CEDAR RAPIDS, IOWA
H.H. SCHWOB, U.S. Dept. of the Interior, Geological Survey
- 6.0280 FLOOD PROFILES AND FLOOD-PLAIN INFOR-
MATION, LINN COUNTY, IOWA
H.H. SCHWOB, U.S. Dept. of the Interior, Geological Survey
- 15.0008 PLANT SPECIES AS WILDLIFE COVER AND
EROSION CONTROL ON 'MUDEFLATS' IN IOWA'S
LARGE RESERVOIR SYSTEMS
J.A. WILSON, Iowa State University, Water Resources
Research Inst.

Cedar Falls

- 6.0277 FLOOD PROFILES AND FLOOD-PLAIN INFOR-
MATION FOR UNIVERSITY BRANCH, DRY RUN
CREEK, CEDAR FALLS, IOWA
O.G. LARA, U.S. Dept. of the Interior, Geological Survey

H.H. SCHWOB, U.S. Dept. of the Interior, Geological Survey

Linn County

- 6.0275 FLOOD PROFILES & FLOOD-PLAIN INFOR-
MATION, LINN COUNTY, IOWA
O.G. LARA, U.S. Dept. of the Interior, Geological Survey
- 6.0280 FLOOD PROFILES AND FLOOD-PLAIN INFOR-
MATION, LINN COUNTY, IOWA
H.H. SCHWOB, U.S. Dept. of the Interior, Geological Survey

Iowa River

- 6.0272 ECONOMIC FACTORS AFFECTING CHANGES
IN THE INTENSITY OF FLOOD PLAIN USE
J.R. BARNARD, Iowa State University, Water Resources
Research Inst.
- 6.0273 THE HUMAN ECOLOGICAL IMPACT OF
STRUCTURAL FLOOD CONTROL ON THE IOWA
RIVER, IOWA
J.S. GARDNER, Iowa State University, Water Resources
Research Inst.

James River

- 6.0396 NUMERICAL STUDIES OF UNSTEADY FLOW
IN THE JAMES RIVER - VIRGINIA
D.N. CONTRACTOR, Virginia Polytechnic Institute, School
of Engineering
- 8.0135 OPERATION AGNIES
A. KUO, Virginia Inst. of Marine Sci.

Jekyll Island

- 15.0007 JEKYLL ISLAND, GEORGIA, BEACH EROSION
CONTROL AND HURRICANE PROTECTION
UNKNOWN, U.S. Army, Engineer District

Kaneohe Bay

- 6.0252 HAWAII ENVIRONMENTAL SIMULATION
MODEL
D.C. COX, Univ. of Hawaii, School of Arts

Kansas

- 2.0013 DROUGHT IN KANSAS
M.J. BROWN, Kansas State University, Agricultural
Experiment Sta.

KANSAS - NORTH SECTOR UPPER WALNUT
WATERSHED BUTLER AND CHASE COUNTIES
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

BIG CREEK WATERSHED, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

MACADOO ROAD-FILL DAM, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

EFFECT OF URBANIZATION ON FLOOD RU-
NOFF - WICHITA AREA, KANSAS

C.O. GEIGER, U.S. Dept. of the Interior, Geological Survey

EFFECT OF URBANIZATION ON FLOOD RU-
NOFF - WICHITA AREA

D.B. RICHARDS, U.S. Dept. of the Interior, Geological Sur-
vey

FORT SCOTT LAKE, MARMATON RIVER, KAN-
SAS
UNKNOWN, U.S. Army, Engineer District

BARBER COUNTY

MACADOO ROAD-FILL DAM, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

BOURBON COUNTY

FORT SCOTT LAKE, MARMATON RIVER, KAN-
SAS
UNKNOWN, U.S. Army, Engineer District

BUTLER COUNTY

KANSAS - NORTH SECTOR UPPER WALNUT
WATERSHED BUTLER AND CHASE COUNTIES
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

KANSAS - NORTH SECTOR UPPER WALNUT
WATERSHED BUTLER AND CHASE COUNTIES
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

CHASE COUNTY

KANSAS - NORTH SECTOR UPPER WALNUT
WATERSHED BUTLER AND CHASE COUNTIES
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

KANSAS - NORTH SECTOR UPPER WALNUT
WATERSHED BUTLER AND CHASE COUNTIES

6.0202 BIG CREEK WATERSHED, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

LABETTE COUNTY

6.0141 BIG HILL LAKE, BIG HILL CREEK, KANSAS
UNKNOWN, U.S. Army, Engineer District

LYON COUNTY

6.0202 BIG CREEK WATERSHED, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

PRATT COUNTY

6.0203 MACADOO ROAD-FILL DAM, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

WICHITA

6.0281 EFFECT OF URBANIZATION ON FLOOD RU-
NOFF - WICHITA AREA, KANSAS

C.O. GEIGER, U.S. Dept. of the Interior, Geological Survey

6.0282 EFFECT OF URBANIZATION ON FLOOD RU-
NOFF - WICHITA AREA

D.B. RICHARDS, U.S. Dept. of the Interior, Geological Sur-
vey

WOODSON COUNTY

6.0202 BIG CREEK WATERSHED, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
Service

Kansas River

6.0314 DEMONSTRATION OF THE ELECTRIC ANALOG
MODEL OF THE KANSAS RIVER AT THE UNIVER-
SITY OF CALIFORNIA IN BERKELEY
UNKNOWN, U.S. Army, Waterways Experiment Station

Kennebec River

6.0288 DATA AND MANAGEMENT NEEDS FOR
WATER RELATED LAND AREAS - MAINE
E. KEENE, North Kennebec Reg. Pln. Comm.

Kentucky

- 3.0174 NEW MADRID EARTHQUAKE - ARKANSAS, ILLINOIS, KENTUCKY, MISSISSIPPI, MISSOURI AND TENNESSEE
M.F. KANE, U.S. Dept. of the Interior, Geological Survey

- 3.0270 REGIONAL EARTHQUAKE RISK STUDY - MISSOURI, ARKANSAS, KENTUCKY, TENNESSEE, MISSISSIPPI AREA
UNKNOWN, Mississippi Ark. Tenn. Council

- 6.0093 FLOOD-FREQUENCY STUDY - KENTUCKY
C.H. HANNUM, U.S. Dept. of the Interior, Geological Survey

- 6.0200 HURRICANE CREEK WATERSHED STRUCTURAL PROJECT MEASURE, KENTUCKY
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

- 6.0283 ZONING ORDINANCE AND ORDER, PIKE COUNTY, ELKHORN CITY, KENTUCKY
UNKNOWN, State Program Dev. Office

- 6.0284 ZONING ORDINANCE - PAINTSVILLE, KENTUCKY
UNKNOWN, State Program Dev. Office

- 6.0285 OUPSET - PROGRAM FOR COMPUTERIZED SELECTION OF WATERSHED PARAMETER VALUES FOR THE STANFORD WATERSHED MODEL.
E.Y. LIU, Univ. of Kentucky, Water Resources Institute

- 6.0286 FLOOD PLAN FOR BULLITT COUNTY, KENTUCKY
A. IVAHBY, Bullitt Co. Planning Comm.

- 6.0312 MODEL STUDY OF CANNELTON LOCKS AND DAM, OHIO RIVER, INDIANA AND KENTUCKY
J.J. FRANCO, U.S. Army, Waterways Experiment Station

- 9.0015 LANDSLIDES - KENTUCKY
C.T. GORMAN, State Bur. of Highways

- 10.0007 ROCK MECHANICS STUDY OF SHORSTALL MINING - KENTUCKY
F.D. WRIGHT, Univ. of Kentucky, School of Engineering

BULLITT COUNTY

- 6.0286 FLOOD PLAN FOR BULLITT COUNTY, KENTUCKY
A. IVAHBY, Bullitt Co. Planning Comm.

ELKHORN CITY

- 6.0283 ZONING ORDINANCE AND ORDER, PIKE COUNTY, ELKHORN CITY, KENTUCKY
UNKNOWN, State Program Dev. Office

HOPKINS COUNTY

- 6.0200 HURRICANE CREEK WATERSHED STRUCTURAL PROJECT MEASURE, KENTUCKY
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

PAINTSVILLE

PIKE COUNTY

- 6.0283 ZONING ORDINANCE AND ORDER, PIKE COUNTY, ELKHORN CITY, KENTUCKY
UNKNOWN, State Program Dev. Office

Key Biscayne

- 15.0015 COASTAL WORKS EVALUATION - CALIFORNIA, FLORIDA
UNKNOWN, U.S. Army, Coastal Engin. Res. Center

- 15.0017 A STUDY OF NEARSHORE PROCESSES IN SOUTHEAST FLORIDA
C. EMILIANI, Univ. of Miami, School of Marine Science

Kissimmee River

- 6.0066 AN OPTIMUM WATER ALLOCATION MODEL BASED ON AN ANALYSIS FOR THE KISSIMMEE RIVER BASIN - FLORIDA
J.E. REYNOLDS, Univ. of Florida, School of Agriculture

Klamath Mountains

- 3.0080 SEISMICITY OF MENDOCINO ESCARPMENT - GORDA RIDGE REGION - CALIFORNIA
E.G. KETHI, Univ. of California, Seismographic Station

Lake Champlain

- 6.0393 SURVEY OF LAKE FLOODING FROM ERTS. I - LAKE CHAMPLAIN
A.O. LIND, Univ. of Vermont, School of Arts

Lake Erie

- 6.0116 DESIGN FOR FLOOD CONTROL AND WAVE PROTECTION, CHAGRIN RIVER, EASTLAKE, OHIO - HYDRAULIC MODEL INVESTIGATION
C.E. CHATHAM, U.S. Army, Waterways Experiment Station
- 8.0113 MARINE ENVIRONMENTAL PREDICTION
N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab.

- 15.0030 SHORE EROSION STUDY OF ERIE COUNTY, OHIO
L.L. BRAIDECH, State Div. of Geolog. Survey

- 15.0031 SHORE EROSION STUDY OF LAKE COUNTY, OHIO
L.L. BRAIDECH, State Div. of Geolog. Survey
- 15.0032 SHORE EROSION STUDIES ALONG THE OHIO

Lake Michigan
DEVELOPMENT OF A FLOOD AND POLLUTION
PLAN FOR THE CHICAGO AND AREA
RIVER SIMULATION PROGRAMS
CHILL, Illinois Inst. For Envir. Qbty

PHYSICAL DATA - SUMMARY REPORT OF
TEN TASKS
ON, Environmental Res. Inst. Mich.
LINE ENVIRONMENTAL PREDICTION
U.S. Dept. of Commerce, Techniques Develop-

RELATION MODEL FOR STORM CYCLES
CH EROSION ON LAKE MICHIGAN
Williams College, Graduate School
FILE OF A STORM - WIND, WAVES AND
ON THE SOUTHEASTERN SHORE OF
CHIGAN
Williams College, Graduate School

Lake Okeechobee
RAIL FLOODING STUDY PROJECT
DEN, U.S. Dept. of Commerce, Research Hydr-

IDA CONJUGUS STUDING EXPERIMENT
UGHT MITIGATION, APRIL-MAY 1974
OLEY, U.S. Dept. of Commerce, Environ-
Laboratories
PERIOD WAVES AND SURGES
U.S. Army, Coastal Engin. Res. Center

Lake Ontario
NAGE STUDY - INVENTORY AND ANALY
Genesee Finger Lake Reg. Board
ERICAL STUDIES IN THE FIFTY-FOUR
RM SURGES IN LAKE ONTARIO
niv. of Wisconsin, School of Earths

Lake Pontchartrain
PONTCHARTRAIN, LOUISIANA - AND
- HURRICANE PROTECTION PROJECT
U.S. Army, Engineer District
TIS ON LAKE PONTCHARTRAIN - FA-
NE SURGE CONTROL STRUCTURES AND
PI RIVER-GUET OF THE CHANNEL
T, U.S. Army, Waterways Experiment Station

Lake Superior
RUE MAPPE ENVIRONMENTAL PREDICTION
A. A. TOR, U.S. Dept. of Commerce, Techniques Develop-

Lewis Range
80021 A MODEL OF THE FORECAST OF GLACIER NA-
TIOAL PARK, MONTANA
R. H. WHITEHEAD, U.S. Geol. Surv., School of Biological
Science

Long Island Sound
150021 ENVIRONMENTAL GEOMORPHIC STUDY OF
THE COASTAL REGIONS ALONG THE SOUTH
SHORE OF LONG ISLAND, NEW YORK
J. R. COLEMAN, U.S. Geol. Surv., School of Arts
150028 GEOM. STUDY OF THE SOUTH SHORE OF
MIDDLE COAST OF LONG ISLAND, NEW YORK,
BETWEEN COCKS COVE AND POULTEEFERSON
HARBOR
J. COLEMAN, U.S. Geol. Surv., School of Arts

Los Angeles Basin
900029 GEOLOGY OF THE POCOS HUSH QUADRAN-
GE AND THE PASADENA COUNTY PART OF
THE TOPONGA QUADRANGLE, LOS ANGELES
CO. CALIFORNIA - C. SCHODEN
R. H. COLEMAN, U.S. Geol. Surv., Interior Geological Sur-

Louisiana
80004 GEOM. STUDY OF AGRANGE AND THE
UNINCORPORATED PART OF THE TOPONGA
QUADRANGLE, LOS ANGELES COUNTY, CALIFOR-
NIA - C. SCHODEN
R. H. COLEMAN, U.S. Geol. Surv., Interior Geological Survey

Lake Superior
900021 EXAMINATION OF CRITERIA FOR LANDSLIDE
ANALYSIS AS PRESENTED BY THE U.S. GEO-
LOGICAL SURVEY, Dept. of the Interior, Bureau of Reclama-
tion

Lake Superior
80004 MAPPE ENVIRONMENTAL PREDICTION
A. A. TOR, U.S. Dept. of Commerce, Techniques Develop-

Lewis Range
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TIOAL PARK, MONTANA
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R. H. COLEMAN, U.S. Geol. Surv., Interior Geological Survey

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R. H. COLEMAN, U.S. Geol. Surv., Interior Geological Survey

Louisiana
80004 GEOM. STUDY OF AGRANGE AND THE
UNINCORPORATED PART OF THE TOPONGA
QUADRANGLE, LOS ANGELES COUNTY, CALIFOR-
NIA - C. SCHODEN
R. H. COLEMAN, U.S. Geol. Surv., Interior Geological Survey

- 3.0 8.0014 SURVEY OF GULF COAST STRUCTURAL
DAMAGE RESULTING FROM HURRICANE
CAMILIE, AUGUST 1969
M.E. CRISWELL, U.S. Army, Waterways Experiment Station
- 6.0 8.0030 GRAND ISLE, LOUISIANA, AND VICINITY HUR-
RICANE PROTECTION ASSOCIATED WATER FEA-
TURE, BAYOU LAFOURCHE - LOUISIANA (AB-
BREV)
UNKNOWN, U.S. Army, Engineer District
- 6.0 8.0031 NEW ORLEANS TO VENICE, LOUISIANA, HUR-
RICANE PROTECTION
UNKNOWN, U.S. Army, Engineer District
- 6.0 8.0032 LAKE PONTCHARTRAIN, LOUISIANA AND
VICINITY - HURRICANE PROTECTION PROJECT
UNKNOWN, U.S. Army, Engineer District
- 6.0 8.0048 EFFECTS ON LAKE PONTCHARTRAIN, LA., OF
HURRICANE SURGE CONTROL STRUCTURES AND
MISSISSIPPI RIVER-GULF OUTLET CHANNEL
I.C. TALLANT, U.S. Army, Waterways Experiment Station
- 6.0 8.0074 HURRICANE CAMILIE - AUGUST 1969
R.D. DIKERS, U.S. Dept. of Commerce, Building Research
Div.
- 6.0 12.0015 MISSISSIPPI DELTA TORNADOES OF FEBRU-
ARY 21, 1971 - A REPORT TO THE ADMINISTRATOR
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & At-
mos. Admin
9. 15.0021 NATIONAL SHORELINE STUDY - INVENTORY
REPORT - LOWER MISSISSIPPI REGION
UNKNOWN, U.S. Army, Engineer District
- 10 16.0059 EMERGENCY OPERATIONS CONTINGENCY
PLANNING - NEW ORLEANS, LOUISIANA
A.I. ABERSMAN, System Development Corporation
6. 16.0082 CLIMATOLOGICAL ASSESSMENT OF URBAN
EFFECTS ON PRECIPITATION - PART I
F.A. HUFF, State Water Survey

FRANKLIN

- 6.0099 MORGAN CITY, LOUISIANA, AND VICINITY
(FRANKLIN AND VICINITY AREA)
UNKNOWN, U.S. Army, Engineer District

LAFOURCHE PARISH

- 6 8.0030 GRAND ISLE, LOUISIANA, AND VICINITY HUR-
RICANE PROTECTION ASSOCIATED WATER FEA-
TURE, BAYOU LAFOURCHE - LOUISIANA (AB-
BREV)
UNKNOWN, U.S. Army, Engineer District

MORGAN CITY

- 6 6.0099 MORGAN CITY, LOUISIANA, AND VICINITY
(FRANKLIN AND VICINITY AREA)
UNKNOWN, U.S. Army, Engineer District

- HURRICANE SURGE CONTROL STRUCTURES AND
MISSISSIPPI RIVER-GULF OUTLET CHANNEL
I.C. TALLANT, U.S. Army, Waterways Experiment Station
- 16.0059 EMERGENCY OPERATIONS CONTINGENCY
PLANNING - NEW ORLEANS, LOUISIANA
A.I. ABERSMAN, System Development Corporation

Maine

- 6.0287 SMALL STREAMS FLOOD FREQUENCY IN
MAINE
G.S. HAYES, State Highway Commission
- 6.0288 DATA AND MANAGEMENT NEEDS FOR
WATER RELATED LAND AREAS - MAINE
E. KEENE, North Kennebec Reg. Pln. Comm.

Manati River

- 6.0362 FLOOD CONTROL STUDY OF RIO GRANDE DE
MANATI, MANATI AND BARCELONETA, PUERTO
RICO
UNKNOWN, State Planning Board

Marmaton River

- 6.0315 FORT SCOTT LAKE, MARMATON RIVER, KAN-
SAS
UNKNOWN, U.S. Army, Engineer District

Marthas Vineyard

- 15.0023 SEA-CLIFF EROSION STUDIES, MAS-
SACHUSETTS
C.A. KAYE, U.S. Dept. of the Interior, Geological Survey

Maryland

- 6.0302 FLOODS FROM SMALL DRAINAGE AREAS -
MARYLAND
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 8.0002 COASTAL STORM DAMAGE WITH SPECIAL
REFERENCE TO THE DELMARVA REGION OF
DELAWARE, MARYLAND, VIRGINIA
F.J. SWAYE, Univ. of Delaware, School of Arts
- 8.0005 ATLANTIC HURRICANE SEASON OF 1972
R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather
Service

BENEDICT

61- BUDGET REALIGNMENT - NEW
MARYLAND
Army, Coastal Engin. Res. Center

60120 FLOOD CONTROL PROJECT - HOOPER RIVER
NORTH ADAMS, MASSACHUSETTS
UNKNOWN U.S. Army, Waterways Experiment Station

BRIDGES

60295 BRIDGE OF STERKONK ZONING BY LAW - 15
NOVEMBER 1969
FEDERAL BUREAU OF COMMUNITY AFF.

Massachusetts

61- CHARACTERISTICS OF SMALL
MASSACHUSETTS

61-5 Dept. of the Interior, Ecological Sur-
VEILLANCE CONTROL PROJECT - HOOPER RIVER
MASSACHUSETTS

Army, Waterways Experiment Station
61-5 DEPARTMENT OF STERKONK ZONING BY LAW - 15
NOVEMBER 1969
State Dept. of Community Aff.

61-5 DEPARTMENT OF STERKONK ZONING BY LAW - 15
NOVEMBER 1969
Army, New England Division

61-5 DEPARTMENT OF STERKONK ZONING BY LAW - 15
NOVEMBER 1969
Army, New England Division

61-5 CHARACTERISTICS OF THE
RIVERS, WARHAM MARION, MASS.
- HYDRAULIC MODEL INVESTIGATION

61-5 Army, Waterways Experiment Station
61-5 EROSION STUDIES - MASS.
Dept. of the Interior, Ecological Survey

MARION

61-5 CHARACTERISTICS OF THE
RIVERS, WARHAM MARION, MASS.
- HYDRAULIC MODEL INVESTIGATION
61-5 Army, Waterways Experiment Station

MAINE

61-5 EROSION STUDIES - MASS.
Dept. of the Interior, Ecological Survey

New Bedford

61-5 DEPARTMENT OF STERKONK ZONING BY LAW - 15
NOVEMBER 1969
Army, New England Division

MASSACHUSETTS

60111 BUDGET REALIGNMENT - NEW
MARYLAND
Army, Waterways Experiment Station

Memphis Bay

61-5 DEPARTMENT OF STERKONK ZONING BY LAW - 15
NOVEMBER 1969
FEDERAL BUREAU OF COMMUNITY AFF.

Memphis River

60111 BUDGET REALIGNMENT - NEW
MARYLAND
Army, Waterways Experiment Station

Mexico

60111 BUDGET REALIGNMENT - NEW
MARYLAND
Army, Waterways Experiment Station

60111 BUDGET REALIGNMENT - NEW
MARYLAND
Army, Waterways Experiment Station

Michigan

60295 BRIDGE OF STERKONK ZONING BY LAW - 15
NOVEMBER 1969
FEDERAL BUREAU OF COMMUNITY AFF.

60295 BRIDGE OF STERKONK ZONING BY LAW - 15
NOVEMBER 1969
FEDERAL BUREAU OF COMMUNITY AFF.

MONROE COUNTY

- 6.0298 USE OF ERIS-1 DATA - SUMMARY REPORT OF WORK ON TEN TASKS
F.J. THOMSON, Environmental Res. Inst. Mich

TRAVERSE CITY

- 15.0026 COASTAL ZONE AND SHORELANDS MANAGEMENT - GREAT LAKES
J.M. ARMSTRONG, Univ. of Michigan, School of Engineering

Midway Island

- 13.0025 THE MAJOR TSUNAMI IN THE HAWAIIAN ISLANDS
UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey

Minnesota

- 3.0115 EARTHQUAKE CONTRDL. EXPERIMENT - MINNESOTA
J.H. DIETERICH, U.S. Dept. of the Interior, Geological Survey
- 5.0016 FIRE WEATHER & BEHAVIOR OF THE LITTLE SIOUX FIRE - MINNESOTA
R.W. SANDO, U.S. Dept. of Agriculture, North Cen. Forest Expt. Sta.
- 6.0300 AN ECONOMIC ANALYSIS OF FLOOD DAMAGE REDUCTION ALTERNATIVES IN THE MINNESOTA RIVER BASIN
A.R. HOPEMAN, Univ. of Minnesota, Water Resources Research Ctr.
- 6.0303 WATER RESOURCES OF THE RED RIVER OF THE NORTH DRAINAGE BASIN IN MINNESOTA
R.W. MACLAY, U.S. Dept. of the Interior, Geological Survey
- 6.0304 FLOOD PLAIN STUDIES--MINNESOTA
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0305 FLOOD PLAIN MANAGEMENT STUDIES - LOWER MINNESOTA RIVER
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0306 SOCIO-ECONOMIC IMPLICATIONS OF ALTER-NATIVE WATER RESOURCES POLICIES IN MINNESOTA
J.J. WAELTI, Univ. of Minnesota, School of Agriculture
- 16.0086 ROLE PERFORMANCE IN THE OPERATING SYSTEM - CIVIL DEFENSE OPERATIONS IN DIS-ASTER
C.L. MULFORD, Iowa State University, School of Science

Minnesota River

- 6.0300 AN ECONOMIC ANALYSIS OF FLOOD DAMAGE REDUCTION ALTERNATIVES IN THE MINNESOTA

- 6.0302 THE EFFECTIVENESS OF FLOOD CONTROL STRUCTURE OF THE LOWER MINNESOTA RIVER WATERSHED DISTRICT
UNKNOWN, Lower Minn. Riv. Wtrshed Dist
- 6.0305 FLOOD PLAIN MANAGEMENT STUDIES - LOWER MINNESOTA RIVER
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

Mississippi

- 2.0015 SEVERITY AND FREQUENCY OF DROUGHT IN MISSISSIPPI
J.C. MCWHORTER, Mississippi St. University, School of Agriculture
- 3.0174 NEW MADRID EARTHQUAKE - ARKANSAS, IL-INOIS, KENTUCKY, MISSISSIPPI, MISSOURI AND TENNESSEE
M.F. KANE, U.S. Dept. of the Interior, Geological Survey
- 3.0236 A MICROEARTHQUAKE STUDY OF THE LOWER MISSISSIPPI VALLEY - ARKANSAS, MISSISSIPPI AND TENNESSEE
O.W. NUTTLI, St. Louis University, Graduate School
- 3.0269 EARTHQUAKE RISK EVALUATION - CRITTEN-DEN COUNTY, ARKANSAS, DESOTO COUNTY, MISSISSIPPI, AND SHELBY COUNTY, TENNESSEE
F. KELLOGG, Mississippi Ark. Tenn. Council
- 3.0270 REGIONAL EARTHQUAKE RISK STUDY - MIS-SOURI, ARKANSAS, KENTUCKY, TENNESSEE, MISSISSIPPI AREA
UNKNOWN, Mississippi Ark. Tenn. Council
- 4.0009 MAPPING OF SURFACE MATERIALS FOR PRE-DICTING FOUNDATION CHARACTERISTICS IN FU-TURE DEVELOPMENT OF HATTIESBURG
B.W. BROWN, Univ. of Southern Mississippi, School of Science
- 5.0017 RESEARCH AND DEVELOPMENT OF FIRE PREVENTION TECHNOLOGY (FIRE PREVENTION)
M.L. DOOLITTLE, Mississippi St. University, U.S.D.A. S. Forest Expt. Sta.
- 6.0065 FLDOD FREQUENCY IN SMALL DRAINAGE AREAS - MISSISSIPPI
K.V. WILSON, U.S. Dept. of the Interior, Geological Survey
- 6.0114 BRIDGE SITE INVESTIGATIONS
C.H. TATE, U.S. Dept. of the Interior, Geological Survey
- 6.0115 SPECIAL FLOOD REPORTS - MISSISSIPPI
C.H. TATE, U.S. Dept. of the Interior, Geological Survey
- 6.0307 URBAN SYSTEMS - STORM DRAINAGE & FLOOD PLAIN MANAGEMENT, SANITARY SEWERAGE, SOLID WASTE MANAGEMENT (AB-BREV)
J.A. ELLIOTT, Diversified Consultants Inc.
- 6.0308 URBAN SYSTEMS - WATERWORKS, SANITARY SEWERAGE, SOLID WASTE MANAGEMENT, STORM DRAINAGE & FLOOD PLAIN MANAGEMENT (AB-BREV)
J.A. ELLIOTT, Diversified Consultants Inc.
- 6.0309 ZONING ORDINANCE AND SUBDIVISION REGULATIONS, FLOOD DAMAGE PREVENTION

THE NATURE AND EXTENT OF STRUCTURAL
DAMAGE CAUSED BY HURRICANE CAMILLE
FFIR, Unknown Inst. or Indiv. Grant

REGIONAL CODE ENFORCEMENT - HANCOCK,
HARRISON AND JACKSON COUNTIES, MISSISSIPPI
MONTJOY, Coast Code Administration

GRANT TO DESIGN A REBUILDING PLAN FOR
GULFPORT, MISSISSIPPI, TO RESTORE THE
DAMAGE OF HURRICANE CAMILLE, VOLUMES I,
II, & III (ABBREV)

BROWN, State Res. & Dev. Center

GRANT TO DESIGN A REBUILDING PLAN FOR
GULFPORT, MISSISSIPPI, TO RESTORE THE
DAMAGE OF HURRICANE CAMILLE, VOLUMES IV
(ABBREV)

BROWN, State Res. & Dev. Center

SURVEY OF GULF COAST STRUCTURAL
DAMAGE RESULTING FROM HURRICANE
CAMILLE, AUGUST 1969

WISWELL, U.S. Army, Waterways Experiment Station
THE EFFECTS OF HURRICANE CAMILLE ON
INDUSTRY, PUBLIC UTILITIES, AND PUBLIC
WORKS OPERATIONS

ACK, U R S Systems Corporation

HURRICANE CAMILLE - AUGUST 1969

WICKERS, U.S. Dept. of Commerce, Building Research

WIND AND SURGE DAMAGE DUE TO HUR-
RICANE CAMILLE

COM, U.S. Dept. of Commerce, Natl. Bureau of Stand-

SHUCKER LAKE LANDSLIDE, MONROE COUNTY,
MISSISSIPPI

SEADY, State Geol. Survey

STATUS OF LAND SUISIDENCE DUE TO
GROUND-WATER WITHDRAWAL IN MISSISSIPPI

SEADY, Mississippi St. University, School of Arts

MISSISSIPPI DELTA TORNADOES OF FEBRU-
ARY, 1971 - A REPORT TO THE ADMINISTRATOR
BROWN, U.S. Dept. of Commerce, Natl. Oceanic & At-
mospheric Admin.

COORDINATED ACCIDENT RESCUE EN-
GINEERING, STATE OF MISSISSIPPI (PROJECT CARE-
FREE) - VOLUME I - OPERATION STRUCTURE AND
PROCEDURES

ARK, Mississippi St. University, School of Engineer-

BILOXI

GRANT TO DESIGN A REBUILDING PLAN FOR
GULFPORT, MISSISSIPPI, TO RESTORE THE
DAMAGE OF HURRICANE CAMILLE, VOLUMES IV
(ABBREV)

BROWN, State Res. & Dev. Center

WIND AND SURGE DAMAGE DUE TO HUR-
RICANE CAMILLE

3.0269 EARTHQUAKE RISK EVALUATION - CRITTEN-
DEN COUNTY, ARKANSAS, DESOTO COUNTY, MIS-
SISSIPPI, AND SHELBY COUNTY, TENNESSEE
F. KELLOGG, Mississippi Ark. Tenn. Council

FRIARS POINT

6.0309 ZONING ORDINANCE AND SUBDIVISION
REGULATIONS, FRIARS POINT, MISSISSIPPI
P.J. BARLOW, State Comm. & Area Dev. Div.

GULFPORT

8.0011 GRANT TO DESIGN A REBUILDING PLAN FOR
GULFPORT, MISSISSIPPI, TO RESTORE THE
DAMAGE OF HURRICANE CAMILLE, VOLUMES I,
II, & III (ABBREV)

UNKNOWN, State Res. & Dev. Center

8.0012 GRANT TO DESIGN A REBUILDING PLAN FOR
GULFPORT, MISSISSIPPI, TO RESTORE THE
DAMAGE OF HURRICANE CAMILLE, VOLUMES IV
& V (ABBREV)

UNKNOWN, State Res. & Dev. Center

HANCOCK COUNTY

6.0308 URBAN SYSTEMS - WATERWORKS, SANITARY
SEWERAGE, SOLID WASTE MANAGEMENT, STORM
DRAINAGE & FLOOD PLAIN MANAGEMENT (AB-
BREV)

J.A. ELLIOTT, Diversified Consultants Inc.

8.0010 REGIONAL CODE ENFORCEMENT - HANCOCK,
HARRISON AND JACKSON COUNTIES, MISSISSIPPI
P. MONTJOY, Coast Code Administration

HARRISON COUNTY

6.0308 URBAN SYSTEMS - WATERWORKS, SANITARY
SEWERAGE, SOLID WASTE MANAGEMENT, STORM
DRAINAGE & FLOOD PLAIN MANAGEMENT (AB-
BREV)

J.A. ELLIOTT, Diversified Consultants Inc.

8.0010 REGIONAL CODE ENFORCEMENT - HANCOCK,
HARRISON AND JACKSON COUNTIES, MISSISSIPPI
P. MONTJOY, Coast Code Administration

HATTIESBURG

4.0009 MAPPING OF SURFACE MATERIALS FOR PRE-
DICTING FOUNDATION CHARACTERISTICS IN FUTURE
DEVELOPMENT OF HATTIESBURG

B.W. BROWN, Univ. of Southern Mississippi, School of
Science

- 6.0310 CITY OF JACKSON, MISSISSIPPI, WATER RESOURCES STUDY
B.E. WASSON, U.S. Dept. of the Interior, Geological Survey
- 6.0311 CITY OF JACKSON WATER RESOURCES STUDY
K.V. WILSON, U.S. Dept. of the Interior, Geological Survey

JACKSON COUNTY

- 6.0308 URBAN SYSTEMS - WATERWORKS, SANITARY SEWERAGE, SOLID WASTE MANAGEMENT, STORM DRAINAGE & FLOOD PLAIN MANAGEMENT (ABBREV)
J.A. ELLIOTT, Diversified Consultants Inc.
- 8.0010 REGIONAL CODE ENFORCEMENT - HANCOCK, HARRISON AND JACKSON COUNTIES, MISSISSIPPI
P. MONTJOY, Coast Code Administration

MERIDIAN

- 6.0115 SPECIAL FLOOD REPORTS - MISSISSIPPI
C.H. TATE, U.S. Dept. of the Interior, Geological Survey

MONROE COUNTY

- 9.0053 ACKER LAKE LANDSLIDE, MONROE COUNTY, MISSISSIPPI
D.M. KEADY, State Geol. Survey

PASCAGOULA

- 8.0012 GRANT TO DESIGN A REBUILDING PLAN FOR GULFPORT, MISSISSIPPI, TO RESTORE THE DAMAGE OF HURRICANE CAMILLE, VOLUMES IV & V (ABBREV)
UNKNOWN, State Res. & Dev. Center

PEARL COUNTY

- 6.0308 URBAN SYSTEMS - WATERWORKS, SANITARY SEWERAGE, SOLID WASTE MANAGEMENT, STORM DRAINAGE & FLOOD PLAIN MANAGEMENT (ABBREV)
J.A. ELLIOTT, Diversified Consultants Inc.

SHELBY COUNTY

- 3.0269 EARTHQUAKE RISK EVALUATION - CRITTENDEN COUNTY, ARKANSAS, DESOTO COUNTY, MISSISSIPPI, AND SHELBY COUNTY, TENNESSEE
F. KELLOGG, Mississippi Ark. Tenn. Council

Mississippi Embayment

- 6.0313 MISSISSIPPI BASIN MODEL
UNKNOWN, U.S. Army, Waterways Experiment Station

- 6.0017 UPPER MISSISSIPPI RIVER COMPREHENSIVE BASIN STUDY - VOLUME V, APPENDIX I - FLOOD CONTROL
UNKNOWN, Upper Miss. Riv. Comp. Comm.

- 6.0121 FLOOD CONTROL IN THE LOWER MISSISSIPPI RIVER VALLEY
UNKNOWN, U.S. Army, Lower Miss. Valley Div.

- 6.0209 INVESTIGATION OF ERTS-A IMAGES FOR APPLICATION TO THEMATIC MAPPING, MISSISSIPPI RIVER
D.T. EDSON, U.S. Dept. of the Interior, Geological Survey

- 6.0320 MERAMEC PARK LAKE, UPPER MISSISSIPPI RIVER BASIN, MERAMEC RIVER, MISSOURI
UNKNOWN, U.S. Army, Engineer District

- 8.0008 EFFECTS OF HURRICANE CAMILLE ON THE LANDSCAPE OF THE BRETON-CHANDELIER ISLAND CHAIN AND THE EASTERN PORTION OF THE LOWER MISSISSIPPI DELTA
L.D. BRIGITT, Louisiana State Univ. System, Coastal Studies Institute

- 8.0031 NEW ORLEANS TO VENICE, LOUISIANA, HURRICANE PROTECTION
UNKNOWN, U.S. Army, Engineer District

- 8.0048 EFFECTS ON LAKE PONTCHARTRAIN, L.A., OF HURRICANE SURGE CONTROL STRUCTURES AND MISSISSIPPI RIVER-GULF OUTLET CHANNEL
I.C. TALLANT, U.S. Army, Waterways Experiment Station

- 10.0030 VERIFICATION OF EMPIRICAL METHOD OF DETERMINING RIVERBANK STABILITY (POTAMOLOGICAL INVESTIGATIONS - SOILS PHASE)
C.C. CALHOUN, U.S. Army, Waterways Experiment Station

- 12.0015 MISSISSIPPI DELTA TORNADOES OF FEBRUARY 21, 1971 - A REPORT TO THE ADMINISTRATOR
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

- 15.0021 NATIONAL SHORELINE STUDY - INVENTORY REPORT - LOWER MISSISSIPPI REGION
UNKNOWN, U.S. Army, Engineer District

Mississippi Valley

- 3.0236 A MICROEARTHQUAKE STUDY OF THE LOWER MISSISSIPPI VALLEY - ARKANSAS, MISSISSIPPI AND TENNESSEE
O.W. NUTTLI, St. Louis University, Graduate School

- 3.0237 MAGNITUDE RECURRENCE RELATION FOR CENTRAL MISSISSIPPI VALLEY EARTHQUAKES
O.W. NUTTLI, St. Louis University, Graduate School

Missouri

- 2.0004 STUDIES OF URBAN EFFECTS ON RAINFALL AND SEVERE WEATHER
S.A. CHANGNON, Univ. of Illinois, State Water Survey Office

MISSOURI
St. Louis University, School of Arts
AL EARTHQUAKE RISK STUDY - MIS-
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EA
Mississippi Ark. Tenn. Council
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U.S. Dept. of Agriculture, North Cen. Forest
AY DESIGN FLOODS FOR SMALL DAMS
MISSOURI
GH, Univ. of Missouri, Water Resources
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THE STATES OF ILLINOIS, INDIANA,
OURI AND OHIO
Univ. of Illinois, Water Resources Center
PMENT OF MAGNITUDE AND
Y RELATIONSHIPS OF FLOODS ON
EAMS OF MISSOURI
U.S. Dept. of the Interior, Geological Survey
LOGY OF STREAMS IN ST. LOUIS
TAN AREA
R, U.S. Dept. of the Interior, Geological Sur-
GE REQUIREMENTS TO CONTROL
WS OF MISSOURI STREAMS
U.S. Dept. of the Interior, Geological Survey
LOGY OF STREAMS IN ST. LOUIS
MISSOURI
U.S. Dept. of the Interior, Geological Survey
EC PARK LAKE, UPPER MISSISSIPPI
N, MERAMEC RIVER, MISSOURI
U.S. Army, Engineer District
TION OF SUBSURFACE OPENINGS - IN-
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S. Army, Waterways Experiment Station
CHELTREE TORNADO - A CASE STUDY
U.S. Air Force, Environ. Tech. Appl. Center
TOLOGICAL ASSESSMENT OF URBAN
N PRECIPITATION - PART I
te Water Survey

St. Louis

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E WEATHER
ON, Univ. of Illinois, State Water Survey Divi-
LOGY OF STREAMS IN ST. LOUIS
TAN AREA
R, U.S. Dept. of the Interior, Geological Sur-
LOGY OF STREAMS IN ST. LOUIS
MISSOURI
U.S. Dept. of the Interior, Geological Survey

6.0319 HYDROLOGY OF STREAMS IN ST. LOUIS
COUNTY - MISSOURI
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

Missouri River

6.0313 MISSISSIPPI BASIN MODEL
UNKNOWN, U.S. Army, Waterways Experiment Station

Montana

3.0126 STRAIN STUDIES - CALIFORNIA, NEVADA,
MONTANA
J.C. SAVAGE, U.S. Dept. of the Interior, Geological Survey
3.0127 CRISTAL STRAIN - CALIFORNIA, NEVADA,
MONTANA, UTAH AND NEW MEXICO
J.C. SAVAGE, U.S. Dept. of the Interior, Geological Survey
3.0184 HAMILTON 2 DEGREE
J.D. BELLS, U.S. Dept. of the Interior, Geological Survey
5.0021 A MODEL OF THE FORESTS OF GLACIER NA-
TIONAL PARK, MONTANA
R.H. WHITTAKER, Cornell University, School of Biological
Sciences
6.0125 APPLICATION OF HYDROLOGIC AND
HYDRAULIC RESEARCH TO CULVERT SELECTION
IN MONTANA - VOLUME I - REPORT
E.R. DODGE, Montana State University, School of Engineer-
ing
6.0126 DEVELOPMENT OF AN OPERATIONS MODEL
FOR MONTANA'S WATER RESOURCES, MIDDLE
CREEK RESERVOIR OPERATION
T.T. WILLIAMS, Montana State University, Water Resources
Research Ctr.
6.0321 FLOODPLAIN MAPPING AND PLANNING FOR
THE 50 AND 100 YEAR INTERVAL FLOOD ZONES
OF THE HITTERROOT VALLEY, MONTANA
K.M. NOLAN, Montana State University, Water Resources
Research Ctr.
9.0021 ROCK STRENGTH FROM FAILURE CASES -
POWERHOUSE SLOPE STABILITY STUDY, FORT
PECK DAM, MONTANA
J.V. HAMEL, Hamel Geotechnical Consultants

Monterey Bay

8.0041 WAVE AND SURGE CONDITIONS AFTER
PROPOSED EXPANSION OF MONTEREY HARBOR,
MONTEREY, CALIFORNIA - HYDRAULIC MODEL
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C.E. CHATHAM, U.S. Army, Waterways Experiment Station
8.0042 WAVE AND SURGE ACTION, MONTEREY HAR-
BOR, MONTEREY, CALIFORNIA - MODEL IN-
VESTIGATION
E.P. FORTSON, U.S. Army, Waterways Experiment Station

Narragansett Bay

- 6.0117 DISCHARGE CHARACTERISTICS OF HURRICANE BARRIER, EAST PASSAGE OF NARRAGANSETT BAY, RHODE ISLAND - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station

- 8.0047 PROTECTION OF NARRAGANSETT BAY FROM HURRICANE SURGES

H.B. SIMMONS, U.S. Army, Waterways Experiment Station

- 8.0126 ANALYTICAL PHYSICAL MODEL

F.M. WHITE, Univ. of Rhode Island, School of Engineering

Naugatuck River

- 6.0118 ANSONIA-DERBY LOCAL PROTECTION PROJECT, NAUGATUCK AND HOUSATONIC RIVERS, CONNECTICUT - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station

Navasota River

- 6.0151 ALTERNATE SOLUTIONS TO WATER RESOURCE DEVELOPMENT--A CASE STUDY - TEXAS

D.R. BASCO, Texas A & M University System, School of Engineering

Nebraska

- 2.0016 NEBRASKA DROUGHTS - A STUDY OF THEIR PAST CHRONOLOGICAL AND SPATIAL EXTENT WITH IMPLICATIONS FOR THE FUTURE

M.P. LAWSON, Univ. of Nebraska, School of Arts

- 6.0205 VERDE LANE FLOOD PREVENTION PROJECT MEASURE, NEBRASKA

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

- 7.0014 NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING

UNKNOWN, U.S. Natl. Science Foundation

- 16.0014 CONSOLIDATED SYSTEMS OF EMERGENCY SERVICES - NEBRASKA (PROJECT 20/20)

D.G. PENTERMAN, State Off. of the Adj. Gen.

Cheyenne County

- 6.0205 VERDE LANE FLOOD PREVENTION PROJECT MEASURE, NEBRASKA

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

- 7.0014 NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING

UNKNOWN, U.S. Natl. Science Foundation

7.0014 NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING
UNKNOWN, U.S. Natl. Science Foundation

Nevada

- 3.0117 INSTRUMENTAL STRAIN - CALIFORNIA AND NEVADA

M.J. JOHNSTON, U.S. Dept. of the Interior, Geological Survey

- 3.0126 STRAIN STUDIES - CALIFORNIA, NEVADA, MONTANA

J.C. SAVAGE, U.S. Dept. of the Interior, Geological Survey

- 3.0127 CRUSTAL STRAIN - CALIFORNIA, NEVADA, MONTANA, UTAH AND NEW MEXICO

J.C. SAVAGE, U.S. Dept. of the Interior, Geological Survey

- 3.0133 TECTONICS OF ACTIVE FAULTS - CALIFORNIA AND NEVADA

R.E. WALLACE, U.S. Dept. of the Interior, Geological Survey

- 3.0180 TECTONIC ANALYSIS OF SEISMICALLY ACTIVE ZONES IN NEVADA, IN SUPPORT OF EARTHQUAKE CONTROL EXPERIMENT - CALIFORNIA, NEVADA, UTAH

P.P. ORKILD, U.S. Dept. of the Interior, Geological Survey

- 3.0245 SEISMICITY OF THE SOUTHERN NEVADA REGION, DECEMBER 22, 1971 TO JULY 1, 1972

K.C. BAYER, U.S. Dept. of Commerce, Earth Sciences Laboratory

- 3.0246 EARTHQUAKES RECORDED BY A SEISMOGRAPHIC NETWORK LOCATED IN THE SOUTHERN NEVADA REGION, JANUARY 1-DECEMBER 22, 1971

K.C. BAYER, U.S. Dept. of Commerce, Earth Sciences Laboratory

- 3.0249 SPECTRAL CHARACTERISTICS AND STRESS DROP FOR MICROEARTHQUAKES NEAR FAIRVIEW PEAK, NEVADA

A. RYALL, Univ. of Nevada, School of Mines

- 3.0250 EARTHQUAKE DISTRIBUTION AND MECHANISM OF FAULTING IN THE RAINBOW MOUNTAIN-DIXIE VALLEY-FAIRVIEW PEAK AREA, CENTRAL NEVADA

A. RYALL, Univ. of Nevada, School of Mines

- 3.0258 MICROSEISMICITY AND TECTONICS OF THE NEVADA SEISMIC ZONE

F.J. GUMPER, Columbia University, Lamont Doherty Geol. Observ.

- 6.0322 EVALUATION OF FLOOD PEAK PREDICTION METHODS IN SEMI-ARID REGIONS IN RELATION TO DAM SAFETY

A.B. CUNNINGHAM, Univ. of Nevada, Desert Research Institute

- 7.0016 THUNDERSTORMS AND HAIL DAYS PROBABILITIES IN NEVADA

C.M. SAKAMOTO, U.S. Dept. of Commerce, Natl. Weather Service

- 9.0009 LOCATION OF SLOPE FAILURE PLANES

R.H. MERRILL, U.S. Dept. of the Interior, Bureau of Mines

- 11.0006 A SYNOPSIS CLIMATOLOGY FOR SNOWSTORMS IN NORTHWESTERN NEVADA

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S. Dept. of the Interior, Bureau of Mines

LOVELOCK

NOPTIC CLIMATOLOGY FOR
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S. Dept. of Commerce, Natl. Weather Ser.

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ANALYSIS OF SEISMICALLY AC-
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UTAH

Dept. of the Interior, Geological Survey

RENO

NOPTIC CLIMATOLOGY FOR
IN NORTHWESTERN NEVADA

S. Dept. of Commerce, Natl. Weather Ser.

WINNEMUCCA

NOPTIC CLIMATOLOGY FOR
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New Jersey

2.0018 THE DETERMINATION OF THE FREQUENCY
OF DROUGHT FLOWS OF VARYING DEGREES OF
SEVERITY AND DURATION - NEW JERSEY

E.G. MILLER, U.S. Dept. of the Interior, Geological Survey

6.0022 THE METEOROLOGICAL AND HYDROLOGICAL
ASPECTS OF THE MAY 1968 NEW JERSEY FLOODS
A.S. KACHIC, U.S. Dept. of Commerce, Weather Bureau

6.0127 PRELIMINARY STORM DRAINAGE AND FLOOD
CONTROL PLAN - UNION COUNTY, N.J.

E.T. KILLAM, Union County Planning Board

6.0323 HYDROLOGY OF SUBURBAN AREAS - NEW
JERSEY

K. NATHAN, Rutgers the State University, Agricultural Ex-
periment Sta.

6.0325 FLOOD PLAIN AND PEAK FLOW STUDIES,
NEW JERSEY

T.G. ROSS, U.S. Dept. of the Interior, Geological Survey

6.0326 DETERMINATION OF FLOOD PEAKS, FLOOD
PROFILES, & FLOOD INUNDATION - NEW JERSEY
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

8.0112 JOINT PROBABILITY METHOD OF TIDE
FREQUENCY ANALYSIS APPLIED TO ATLANTIC
CITY AND LONG BEACH ISLAND, NEW JERSEY

P.A. MYERS, U.S. Dept. of Commerce, National Weather
Service

BERGEN

6.0326 DETERMINATION OF FLOOD PEAKS, FLOOD
PROFILES, & FLOOD INUNDATION - NEW JERSEY
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

BERGEN COUNTY

6.0326 DETERMINATION OF FLOOD PEAKS, FLOOD
PROFILES, & FLOOD INUNDATION - NEW JERSEY
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

UNION COUNTY

6.0127 PRELIMINARY STORM DRAINAGE AND FLOOD
CONTROL PLAN - UNION COUNTY, N.J.
E.T. KILLAM, Union County Planning Board

New Mexico

3.0127 CRUSTAL STRAIN - CALIFORNIA, NEVADA,
MONTANA, UTAH AND NEW MEXICO

J.C. SAVAGE, U.S. Dept. of the Interior, Geological Survey

6.0020 FLOOD OF JULY 17, 1972 IN GALLUP, NEW
MEXICO

L.A. WAITE, U.S. Dept. of the Interior, Geological Survey

New England

LAND RIVER BASINS COMMISSION,
ORT, FISCAL YEAR 1971
Water Resources Council

LITICAL ECONOMY OF WATER

University of New York, Agricultural Ex-

CONDITIONS AND AUTOMATED
OR THE ATLANTIC COASTAL STORM
18-20, 1972

Dept. of Commerce, Techniques Develop-

- UNKNOWN, Albuquerque Urban Observatory
- 6.0129 INVESTIGATION AND ANALYSIS OF FLOODS FOR SMALL DRAINAGE AREAS IN NEW MEXICO
A.G. SCOTT, U.S. Dept. of the Interior, Geological Survey
- 6.0201 CORNUDAS, NORTH AND CULP DRAWS WATERSHED, HUDSPETH COUNTY, TEXAS, AND OTERO COUNTY, NEW MEXICO
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0327 FLOOD FREQUENCY STUDY IN NEW MEXICO
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 9.0040 SOCORRO 2 DEGREE QUADRANGLE - NEW MEXICO
G.O. BACHMAN, U.S. Dept. of the Interior, Geological Survey
- 13.0011 TSUNAMI SYSTEMS ENGINEERING - NEW MEXICO AND CALIFORNIA
H.E. CLARK, U.S. Dept. of the Interior, Geological Survey

GALLUP

- 6.0020 FLOOD OF JULY 17, 1972 IN GALLUP, NEW MEXICO
L.A. WAITE, U.S. Dept. of the Interior, Geological Survey

OTERO COUNTY

- 6.0201 CORNUDAS, NORTH AND CULP DRAWS WATERSHED, HUDSPETH COUNTY, TEXAS, AND OTERO COUNTY, NEW MEXICO
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

New York

- 3.0256 COMPILATION OF BRITTLE STRUCTURES WITHIN NEW YORK STATE
Y.W. ISACHSEN, State Dept. of Education
- 6.0130 REGIONAL COMPREHENSIVE MULTI-PURPOSE WATER RESOURCES PLANNING STUDIES IN NEW YORK
J.A. FINCK, State Dept. of Env. Conserv.
- 6.0131 USE OF SYSTEMS ANALYSIS IN THE DEVELOPMENT OF WATER RESOURCES MANAGEMENT PLANS FOR NEW YORK STATE - ADDENDUM
C.S. LIU, State Dept. of Env. Conserv.
- 6.0133 WATER RELATED ENVIRONMENTAL SERVICES
UNKNOWN, Central New York Reg. Pln. Bd.
- 6.0289 CLIMATES OF THE STATES - CLIMATE OF NEW YORK
A.B. PACK, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.
- 6.0328 THE USE OF SYSTEMS ANALYSIS IN THE DEVELOPMENT OF WATER RESOURCES MANAGEMENT PLANS FOR NEW YORK STATE - VOLUME I
A.C. TEDROW, State Div. of Water Resources
- 6.0329 STREAMS AND DRAINAGE BASINS - FULTON COUNTY, NEW YORK
UNKNOWN, State Off. of Plan. Services

- UNKNOWN, State Off. of Plan. Services
- 6.0331 FLOOD INVESTIGATIONS - NEW YORK
B. DUNN, U.S. Dept. of the Interior, Geological Survey
- 6.0332 COMPREHENSIVE PLAN - REPORT C, IMPLEMENTATION - VILLAGE OF EAST AURORA, N.Y., TOWN OF AURORA, N.Y.
UNKNOWN, Aurora Planning Board
- 6.0333 NATURAL CHARACTERISTICS OF COLUMBIA COUNTY, NEW YORK STATE
H.H. LADAGE, Columbia Co. Planning Dept.
- 6.0337 APPLICATION OF LUNR SYSTEM TO FLOOD PLAIN ANALYSIS AND MANAGEMENT IN THE SUSQUEHANNA RIVER BASIN
J.W. KELLEY, State University of New York, Agricultural Experiment Sta.
- 6.0340 DRAINAGE STUDY - INVENTORY AND ANALYSIS
UNKNOWN, Genesee Finger Lake Reg. Board
- 8.0115 MARINE CONDITIONS AND AUTOMATED FORECASTS FOR THE ATLANTIC COASTAL STORM OF FEBRUARY 18-20, 1972
N.A. FORK, U.S. Dept. of Commerce, Techniques Development Lab.
- 8.0119 JAMAICA BAY HURRICANE BARRIER STUDY NEW YORK
T.C. HILL, U.S. Army, Waterways Experiment Station
- 8.0123 PRELIMINARY CLIMATIC DATA REPORT HURRICANE AGNES JUNE 14-23, 1972
R.M. DEANGELIS, U.S. Dept. of Commerce, Natl. Climatic Center
- 9.0010 SHEAR STRENGTH OF FINE-GRAINED SOILS - WEST POINT, NEW YORK
UNKNOWN, Transportation Res. Board
- 15.0009 STATEN ISLAND BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT, STATEN ISLAND, NEW YORK
UNKNOWN, U.S. Army, Engineer District
- 15.0027 ENVIRONMENTAL GEOMORPHIC STUDY OF THE COASTAL REGIMES ALONG THE SOUTH SHORE OF LONG ISLAND - NEW YORK
D.R. COATES, State University of New York, School of Arts
- 15.0028 GROIN STUDY ON THE NORTH SHORE OF SUFFOLK COUNTY, LONG ISLAND, NEW YORK, BETWEEN ORIENT POINT AND PORT JEFFERSON HARBOR
T. OMHOIT, New York Ocean Science Lab.
- 16.0101 DISASTER RELIEF - DOMESTIC ACTION IN THE SPOTLIGHT
E.J. RUSH, U.S. Army, War College

AURORA

- 6.0332 COMPREHENSIVE PLAN - REPORT C, IMPLEMENTATION - VILLAGE OF EAST AURORA, N.Y., TOWN OF AURORA, N.Y.
UNKNOWN, Aurora Planning Board

COLUMBIA COUNTY

- 6.0333 NATURAL CHARACTERISTICS OF COLUMBIA COUNTY, NEW YORK STATE

ION - VILLAGE OF EAST AURORA, N.Y.
OF AURORA, N.Y.

WN, Aurora Planning Board

FULTON COUNTY

REAMS AND DRAINAGE BASINS - FULTON
TY, NEW YORK

WN, State Off. of Plan. Services

NEW YORK CITY

UDY OF SEAWATER DESALTING AS EMER-
Y WATER SUPPLY FOR NEW YORK CITY

EFFER, Parsons Jorden Corporation

PUTNAM COUNTY

TNAM COUNTY OFFICIAL MAP
ALS FOR REVISION AND EXPANSION

WN, State Off. of Plan. Services

STATEN ISLAND

STATEN ISLAND BEACH EROSION CONTROL
HURRICANE PROTECTION PROJECT, STATEN
D, NEW YORK

WN, U.S. Army, Engineer District

SUFFOLK COUNTY

ROIN STUDY ON THE NORTH SHORE OF
K COUNTY, LONG ISLAND, NEW YORK,
EEN ORIENT POINT AND PORT JEFFERSON
OR

OLT, New York Ocean Science Lab.

WEST POINT

EAR STRENGTH OF FINE-GRAINED SOILS -
POINT, NEW YORK

WN, Transportation Res. Board

Nisqually River

OOD PROFILES AND INUNDATED AREAS
G THE LOWER NISQUALLY RIVER,
INGTON

IMANS, U.S. Dept. of the Interior, Geological Sur-

North Carolina

EFFECTS OF URBANIZATION ON FLOODS AT
ON-SALEM, NORTH CAROLINA

NAM, U.S. Dept. of the Interior, Geological Survey

6.0137 USE OF MULTISPECTRAL PHOTOGRAPHY IN
WATER RESOURCE PLANNING AND MANAGE-
MENT IN NORTH CAROLINA

C.H. WEILBY, Univ. of North Carolina, School of Agriculture

6.0342 EFFECTS OF URBANIZATION ON FLOODS IN
CHARLOTTE, NORTH CAROLINA

W.H. EDDINS, U.S. Dept. of the Interior, Geological Survey

6.0343 EFFECTS OF URBANIZATION ON FLOODS AT
MORGANTON, NORTH CAROLINA

A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey

9.0063 DEVELOPMENT OF CRITERIA FOR RECOGNIZ-
ING & IDENTIFYING SLOPE FAILURE FORMS AS
DEPICTED BY REMOTE SENSOR RETURNS -
NORTH CAROLINA

D.H. POOLE, East Tenn. State University, Remote Sensing
Institute

13.0019 LONG-PERIOD WAVES AND SURGES

UNKNOWN, U.S. Army, Coastal Engin. Res. Center

15.0029 EROSION AND DEPOSITION IN THE SOUNDS
AND ESTUARIES OF THE NORTH CAROLINA
COAST

R.L. INGRAM, Univ. of North Carolina, School of Arts

16.0096 THE CHARLOTTE CONSORTIUM TASK I RE-
PORT - VOLUME IIA - ANALYSIS OF MUNICIPAL
ACTIVITIES - PUBLIC SAFETY SUBSYSTEM

UNKNOWN, Unknown Inst. or Indiv. Grant

CHARLOTTE

6.0342 EFFECTS OF URBANIZATION ON FLOODS IN
CHARLOTTE, NORTH CAROLINA

W.H. EDDINS, U.S. Dept. of the Interior, Geological Survey

16.0096 THE CHARLOTTE CONSORTIUM TASK I RE-
PORT - VOLUME IIA - ANALYSIS OF MUNICIPAL
ACTIVITIES - PUBLIC SAFETY SUBSYSTEM

UNKNOWN, Unknown Inst. or Indiv. Grant

DURHAM

6.0135 EFFECTS OF URBANIZATION ON FLOODS AT
DURHAM, NORTH CAROLINA

A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey

LENOIR

6.0136 EFFECTS OF URBANIZATION ON FLOODS AT
LENOIR, NORTH CAROLINA

A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey

MORGANTON

6.0343 EFFECTS OF URBANIZATION ON FLOODS AT
MORGANTON, NORTH CAROLINA

A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey

North Central United States

5.0014 FIRE CONTROL PLANNING AND FIRE PREVENTION IN THE NORTHEASTERN UNITED STATES

V.J. JOHNSON, Michigan State University, U.S.D.A. N. Cen. For. Ex. Sta.

6.0113 FORECASTING RAINFALL AND SNOWMELT FLOODS ON UPPER MIDWESTERN WATERSHEDS

C.E. BOWERS, Univ. of Minnesota, St. Anthony Falls Hydr. Lab.

6.0301 FLOOD FORECASTING IN THE UPPER MIDWEST - DATA ASSEMBLY AND PRELIMINARY ANALYSIS

A.F. PABST, Univ. of Minnesota, St. Anthony Falls Hydr. Lab.

North Dakota

2.0020 DROUGHT AND WET SPELLS IN NORTH DAKOTA

J.M. RAMIREZ, North Dakota State University, Agricultural Experiment Sta.

6.0062 FLOW REGULATION EFFECTS OF THE BURLINGTON RESERVOIR FROM THE DAM DOWNSTREAM TO WESTHOPE, NORTH DAKOTA

J.O. SHEARMAN, U.S. Dept. of the Interior, Geological Survey

6.0138 MAGNITUDE AND FREQUENCY OF FLOOD DISCHARGES FROM SMALL DRAINAGE BASINS, EFFECTS OF DRAINAGE BASIN CHARACTERISTICS - NORTH DAKOTA

O.A. CROSBY, U.S. Dept. of the Interior, Geological Survey

6.0204 STARKWEATHER WATERSHED, NORTH DAKOTA

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

6.0290 PROBABLE MAXIMUM PRECIPITATION AND SNOWMELT CRITERIA FOR RED RIVER OF THE NORTH ABOVE PEMBINA AND SOURIS RIVER ABOVE MINOT, NORTH DAKOTA

J.T. RIEDEL, U.S. Dept. of Commerce, National Weather Service

6.0344 MAGNITUDE AND FREQUENCY OF FLOODS ON SMALL STREAMS - NORTH DAKOTA

O.A. CROSBY, U.S. Dept. of the Interior, Geological Survey

7.0006 WEATHER MODIFICATION IN NORTH DAKOTA

W.J. PROMERSBERGER, North Dakota State University, Agricultural Experiment Sta.

CAVALIER COUNTY

6.0204 STARKWEATHER WATERSHED, NORTH DAKOTA

DAKOTA
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

Northeast United States

5.0014 FIRE CONTROL PLANNING AND FIRE PREVENTION IN THE NORTHEASTERN UNITED STATES

V.J. JOHNSON, Michigan State University, U.S.D.A. N. Cen. For. Ex. Sta.

Northwest United States

3.0280 A STUDY OF SEISMICITY AND CRUSTAL STRUCTURE IN WESTERN WASHINGTON USING A SEISMIC TELEMETRY NETWORK

R.S. CROSSON, Univ. of Washington, School of Arts

Oahu

6.0076 URBAN HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII

Y. FOX, Univ. of Hawaii, Water Resources Research Ctr.

6.0077 FLOOD HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII

Y.S. FOX, Univ. of Hawaii, Water Resources Research Ctr.

6.0078 INSTANTANEOUS UNIT HYDROGRAPH ANALYSIS OF HAWAIIAN SMALL WATERSHEDS

R. IVANG, Univ. of Hawaii, Water Resources Research Ctr.

6.0252 HAWAII ENVIRONMENTAL SIMULATION MODEL

D.C. COX, Univ. of Hawaii, School of Arts

15.0018 DEPOSITION OF HAWAIIAN WATERSHED AND ESTUARINE SEDIMENTS

P. FAN, Univ. of Hawaii, Water Resources Research Ctr.

Ohio

6.0059 INVESTIGATION AND ANALYSIS OF FLOODS FROM SMALL DRAINAGE AREAS IN OHIO

W.P. CROSS, U.S. Dept. of the Interior, Geological Survey

6.0116 DESIGN FOR FLOOD CONTROL AND WAVE PROTECTION, CUYAGIN RIVER, EASTLAKE, OHIO - HYDRAULIC MODEL INVESTIGATION

C.E. CHATHAM, U.S. Army, Waterways Experiment Station

6.0266 AN APPRAISAL OF FLOODPLAIN REGULATIONS IN THE STATES OF ILLINOIS, INDIANA, IOWA, MISSOURI AND OHIO

W.M. KEITH, Univ. of Illinois, Water Resources Center

6.0345 COST-EFFECTIVENESS ANALYSES OF REGIONAL FLOOD PLAIN MANAGEMENT ACTIVITIES

G.M. CLARK, Ohio State University, School of Engineering

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 AB, Ohio State University, School of Agriculture
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 T.L., State Dept. of Transportation
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 ER, U.S. Dept. of Commerce, Weather Bureau
 NIA REBUILDS
 V, Xenia Commission
 ERE EROSION STUDY OF ERIE COUNTY,
 DECH, State Div. of Geolog. Survey
 ERE EROSION STUDY OF LAKE COUNTY,
 DECH, State Div. of Geolog. Survey
 ERE EROSION STUDIES ALONG THE OHIO
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 ER, State Div. of Geolog. Survey
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 E, Ohio State University, School of Medicine
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IGN FOR FLOOD CONTROL AND WAVE
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 IAM, U.S. Army, Waterways Experiment Station

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 DECH, State Div. of Geolog. Survey

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 FROM CHAIRMAN, U. S. WATER RESOURCES
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UNKNOWN, U.S. Water Resources Council

6.0312 MODEL STUDY OF CANNELTON LOCKS AND
 DAM, OHIO RIVER, INDIANA AND KENTUCKY
 J.J. FRANCO, U.S. Army, Waterways Experiment Station

Oklahoma

2.0006 OKLAHOMA DROUGHT RELIEF OPERATIONAL
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J.L. SUTHERLAND, Weather Sciences Incorporated

2.0008 PROJECT ARID DROP, A SUMMARY REPORT
 OF CLOUD SEEDING ACTIVITIES IN ARIZONA AS
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T.J. HENDERSON, Atmospherics Incorporated

2.0009 HYGROSCOPIC SEEDING IN OKLAHOMA -
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P.B. MACCREADY, Flight Test Research Inc.

6.0139 STATEWIDE FLOOD-FREQUENCY REPORT -
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P.B. SAUER, U.S. Dept. of the Interior, Geological Survey

6.0140 INVESTIGATION AND ANALYSIS OF FLOODS
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UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0142 BIRCH LAKE, BIRCH CREEK, OKLAHOMA

UNKNOWN, U.S. Army, Engineer District

6.0206 WHITEWATER CREEK HYDROLOGIC UNIT
 PROJECT MEASURE, CHEROKEE HILLS RC AND D
 PROJECT, OKLAHOMA

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
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6.0217 INVESTIGATION ON ANALYSIS OF FLOODS
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W. THOMAS, U.S. Dept. of the Interior, Geological Survey

6.0350 APPRAISAL OF THE WATER AND RELATED
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UNKNOWN, State Water Resour. Board

6.0351 APPRAISAL OF THE WATER AND RELATED
 LAND RESOURCES OF OKLAHOMA

UNKNOWN, State Water Resour. Board

12.0007 MORPHOLOGY OF TWO TORNADIC STORMS -
 AN ANALYSIS OF NSSL DATA ON APRIL 30, 1970 -
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S.L. BARNES, U.S. Dept. of Commerce, Natl. Severe Storms
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12.0022 OBSERVATIONS OF SEVERE STORMS ON 26
 AND 28 APRIL 1971

C.L. VLCEK, U.S. Dept. of Commerce, Natl. Severe Storms
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12.0023 SEVERE STORM MORPHOLOGY - OKLAHOMA
 S.L. BARNES, U.S. Dept. of Commerce, Environ. Research
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 16.0082 CLIMATOLOGICAL ASSESSMENT OF URBAN EFFECTS ON PRECIPITATION - PART I
 F.A. HUFF, State Water Survey

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- 6.0206 WHITEWATER CREEK HYDROLOGIC UNIT PROJECT MEASURE, CHEROKEE HILLS RC AND D PROJECT, OKLAHOMA
 UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

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- 12.0007 MORPHOLOGY OF TWO TORNADIC STORMS - AN ANALYSIS OF NSSI DATA ON APRIL 30, 1970 - OKLAHOMA CITY, OKLAHOMA
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- 6.0142 BIRCH LAKE, BIRCH CREEK, OKLAHOMA
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- 3.0266 SEISMICITY INVESTIGATIONS IN THE CASCADE MOUNTAINS AND VICINITY, OREGON, 1 MAY 1969 - 30 APRIL 1970
 H.R. BLANK, Univ. of Oregon, School of Liberal Arts
 3.0267 LOST CREEK LAKE PROJECT, ROGUE RIVER, OREGON
 UNKNOWN, U.S. Army, Engineer District
 5.0037 REDUCING FIRE HAZARD IN PONDEROSA PINE THINNING SLASH BY MECHANICAL CRUSHING - OREGON
 J.D. DELL, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta.
 5.0040 FOREST FIRE METEOROLOGY IN THE PACIFIC COASTAL REGION

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DISASTER STUDIES, COUNTIES,

- 12.0030 ESTIMATE OF MAXIMUM WIND SPEEDS OF TORNADOES IN THREE NORTHWESTERN STATES - IDAHO, OREGON, WASHINGTON
 T.T. FUJITA, Univ. of Chicago, School of Physical Sciences
 14.0006 GEODIMETER STUDIES OF CASCADE VOLCANOES - WASHINGTON, OREGON AND CALIFORNIA
 D.A. SWANSON, U.S. Dept. of the Interior, Geological Survey
 14.0008 THERMAL SURVEILLANCE OF VOLCANOES - REMOTE SENSING OF LONG VALLEY IN GEOTHERMAL PROGRAM - WASHINGTON, OREGON AND CALIFORNIA
 J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey
 15.0033 EVALUATION OF GEOLOGIC AND OCEANOGRAPHIC FACTORS INFLUENCING EROSION OF THE OREGON COAST
 J.V. BIRNE, Oregon State University, School of Science
 15.0034 EROSION AND SEDIMENTATION FOLLOWING ROAD CONSTRUCTION AND TIMBER HARVEST ON UNSTABLE SOILS IN THREE SMALL WESTERN OREGON WATERSHEDS
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 8.0111 SPECIAL PROGRAM TO LIST AMPLITUDES OF SURGES FROM HURRICANES - PART 2. GENERAL TRACK AND VARIANT STORM CONDITIONS
 C.P. JELESNIANSKI, U.S. Dept. of Commerce, Techniques Development Lab.

CLATSOP COUNTY

LATAH COUNTY

- 6.0253 NATURAL DISASTER ANALYSIS FOR LATAH COUNTY, IDAHO, JUNE 1973
 H.W. LEE, State Planning & Com. Aff. Agcy

LINCOLN COUNTY

- 6.0354 DEVELOPMENT IN FLOOD-PRONE AREAS OF LINCOLN COUNTY, OREGON AUGUST, 1973
 UNKNOWN, Lincoln Co. Planning Dept.

TILLAMOOK COUNTY

- 8.0111 SPECIAL PROGRAM TO LIST AMPLITUDES OF SURGES FROM HURRICANES - PART 2. GENERAL TRACK AND VARIANT STORM CONDITIONS
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STUDY ON THE PROBLEMS AND
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OSO BAY

Coastal Bend Reg. Comm.

Oso Creek

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Oswego River

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pt. of Env. Conserv.

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Pacific Ocean

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RGIN - ALASKA

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SUNAMI CATALOG

Hawaii, School of Arts

Pamlico Sound

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Army, Coastal Engin. Res. Center

AND DEPOSITION IN THE SOUNDS
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e. of North Carolina, School of Arts

Pearl Harbor

N OF HAWAIIAN WATERSHED
N SEDIMENTS

8.0012 GRANT TO DESIGN A REBUILDING PLAN FOR
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& V (ABBREV)

UNKNOWN, State Res. & Dev. Center

Pennsylvania

6.0008 MENTAL HEALTH SERVICES TO RESIDENTS
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GION, COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, State Dept. of Pub. Welfare

6.0009 MENTAL HEALTH SERVICES TO RESIDENTS
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ING COUNTIES OF THE COMMONWEALTH OF
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UNKNOWN, Hazleton Nanticoke M.H. & M.R.

6.0010 TRAINING AND EVALUATION OF MENTAL
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UNKNOWN, Eastern Penn. Psych. Institute

6.0011 MENTAL HEALTH SERVICES TO RESIDENTS
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ING COUNTIES, COMMONWEALTH OF PENNSYLV-
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UNKNOWN, Luzerne Wyoming Co. M.H. Prog.

6.0024 LOCK HAVEN URBAN RENEWAL PROJECT,
LOCK HAVEN, PENNSYLVANIA

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev.
Disaster Rec. Off.

6.0025 MODEL CITIES ONE - URBAN RENEWAL PRO-
JECT, READING, PENNSYLVANIA

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev.
Disaster Rec. Off.

6.0026 PENN-SUSQUEHANNA URBAN RENEWAL PRO-
JECT, HARRISBURG, PENNSYLVANIA, HUD PRO-
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UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev.
Disaster Rec. Off.

6.0027 MILTON SOUTH, MILTON NORTH AND TUR-
BOY TOWNSHIP DISASTER, URBAN RENEWAL
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UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Special
Recovery Office

6.0028 DOWNTOWN URBAN RENEWAL PROJECT,
WILKES-BARRE, PENNSYLVANIA

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Special
Recovery Office

6.0029 KINGSTON DISASTER URBAN RENEWAL PRO-
JECT, BOROUGH OF KINGSTON, LUZERNE COUN-
TY, PENNSYLVANIA, HUD PROJECT NO. R-615C

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev.
Disaster Rec. Off.

6.0144 OPTIMAL ANTECEDENT PRECIPITATION IN-
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B.M. REICH, Penn. State University, Inst. Res. Land & Wtr.
Resour.

6.0145 FLOOD PREDICTION METHODS FOR PENNSYLV-
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6.0357 THE EFFECT OF GROUND-WATER CONDITIONS ON LOCAL FLOODING IN THE KINGSTON AREA, PENNSYLVANIA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0361 EFFECT OF AGNES FLOODS ON ANNUAL SERIES IN PENNSYLVANIA

B.M. REICH, Penn. State University, Inst. Res. Land & Wtr. Resour.

8.0005 ATLANTIC HURRICANE SEASON OF 1972

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service

8.0009 ASSESSMENT OF THE PHYSICAL AND GEOLOGICAL EFFECTS OF TROPICAL STORM AGNES ON THE UPPER CHESAPEAKE BAY AND SELECTED TRIBUTARIES

J.R. SCHUBEL, Johns Hopkins University, Graduate School

8.0123 PRELIMINARY CLIMATIC DATA REPORT HURRICANE AGNES JUNE 14-23, 1972

R.M. DEANGELIS, U.S. Dept. of Commerce, Natl. Climate Center

9.0002 REGIONAL SLOPE STABILITY STUDIES - CALIFORNIA AND PENNSYLVANIA

D.H. RADBRUCHHALL, U.S. Dept. of the Interior, Geological Survey

16.0079 THE INVESTIGATION OF SHELTER MANAGEMENT AND CONTROL IN NATURAL DISASTER

R.A. COLLINS, Amer. Inst. For Res.

16.0101 DISASTER RELIEF - DOMESTIC ACTION IN THE SPOTLIGHT

E.J. RUSH, U.S. Army, War College

HARRISBURG

6.0026 PENN-SUSQUEHANNA URBAN RENEWAL PROJECT, HARRISBURG, PENNSYLVANIA, HUD PROJECT NO. R-634C

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev. Disaster Rec. Off.

16.0079 THE INVESTIGATION OF SHELTER MANAGEMENT AND CONTROL IN NATURAL DISASTER

R.A. COLLINS, Amer. Inst. For Res.

KINGSTON

6.0029 KINGSTON DISASTER URBAN RENEWAL PROJECT, BOROUGH OF KINGSTON, LUZERNE COUNTY, PENNSYLVANIA, HUD PROJECT NO. R-615C

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev. Disaster Rec. Off.

LUZERNE COUNTY

6.0009 MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN LUZERNE-WYOMING COUNTIES OF THE COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, Hazleton Nanticoke M.H. & M.R.

6.0011 MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN LUZERNE-WYOMING COUNTIES, COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, Luzerne Wyoming Co. M.H. Prog.

6.0029 KINGSTON DISASTER URBAN RENEWAL PROJECT, BOROUGH OF KINGSTON, LUZERNE COUNTY, PENNSYLVANIA, HUD PROJECT NO. R-615C

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev. Disaster Rec. Off.

PITTSBURGH

9.0002 REGIONAL SLOPE STABILITY STUDIES - CALIFORNIA AND PENNSYLVANIA

D.H. RADBRUCHHALL, U.S. Dept. of the Interior, Geological Survey

READING

6.0025 MODEL CITIES ONE - URBAN RENEWAL PROJECT, READING, PENNSYLVANIA

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev. Disaster Rec. Off.

WILKES-BARRE

6.0028 DOWNTOWN URBAN RENEWAL PROJECT, WILKES-BARRE, PENNSYLVANIA

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Special Recovery Office

WYOMING COUNTY

6.0009 MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN LUZERNE-WYOMING COUNTIES OF THE COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, Hazleton Nanticoke M.H. & M.R.

6.0011 MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN LUZERNE-WYOMING COUNTIES, COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, Luzerne Wyoming Co. M.H. Prog.

Perris Valley

PERRIS VALLEY URBAN HYDROLOGY STUDY,
CALIFORNIA
BUSBY, U.S. Dept. of the Interior, Geological Survey

Point Mugu

PRELIMINARY INVESTIGATION OF STRUCTURAL
DAMAGE FROM POINT MUGU, CALIFORNIA
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YAKAHASHI, U.S. Navy, Civil Engineering Lab.

Potomac River

ASSESSMENT OF THE PHYSICAL AND GEOLOGICAL
EFFECTS OF TROPICAL STORMS ON THE UPPER CHESAPEAKE BAY AND
AFFECTED TRIBUTARIES
CHURCH, Johns Hopkins University, Graduate School

Puerto Rico

DEVELOPMENT OF RAINFALL DEFICIENCY INDEX FOR
PUERTO RICO
APIEL, Univ. of Puerto Rico, Agricultural Experiment

VA. SEISMICITY - 32 STATES AND PUERTO RICO
MICKEY, U.S. Dept. of the Interior, Geological Survey
FLOOD-FREQUENCY AND BASIN PARAMETER RELATIONSHIPS IN SMALL DRAINAGE AREAS
RIGGS, U.S. Dept. of the Interior, Geological Survey
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NOVYN, State Planning Board

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STEWART, U.S. Dept. of Commerce, Environ. Research Laboratories

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Puget Sound

3.0020 SEISMIC RISK - FDAA - WASHINGTON AND UTAH
S.T. ALGERMISSEN, U.S. Dept. of the Interior, Geological Survey

3.0146 PUGET SOUND, WASHINGTON, EARTHQUAKE AND THE MANTLE STRUCTURE BENEATH THE NORTHWESTERN UNITED STATES
D. MCKENZIE, Calif. Inst. of Technology, Seismological Laboratory

3.0280 A STUDY OF SEISMICITY AND CRUSTAL STRUCTURE IN WESTERN WASHINGTON USING A SEISMIC TELEMETRY NETWORK
R.S. CROSSON, Univ. of Washington, School of Arts

3.0281 BUILDING STANDARDS AND THE EARTHQUAKE HAZARD FOR THE PUGET SOUND BASIN
B. GONEN, Univ. of Washington, School of Engineering

Ralston Creek

6.0018 URBAN GROWTH, RUNOFF, EXTERNALITIES, AND INCOME DISTRIBUTION EFFECTS IN RALSTON CREEK WATERSHEDS
J.R. BARNARD, Univ. of Iowa, School of Liberal Arts

Rappahannock River

8.0135 OPERATION AGNES
A. KUO, Virginia Inst. of Marine Sci.

Raymond Basin

10.0018 LAND-SUBSIDENCE STUDIES IN CALIFORNIA - TO STUDY THE EXTENT, MAGNITUDE
J.F. POLAND, U.S. Dept. of the Interior, Geological Survey

Red River

6.0062 FLOW REGULATION EFFECTS OF THE BURLINGTON RESERVOIR FROM THE DAM DOWNSTREAM TO WESTHOPE, NORTH DAKOTA
J.O. SHEARMAN, U.S. Dept. of the Interior, Geological Survey

6.0100 RED RIVER EMERGENCY BANK PROTECTION, LOUISIANA, ARKANSAS, AND TEXAS
UNKNOWN, U.S. Army, Engineer District

6.0290 PROBABLE MAXIMUM FLOODING
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ABOVE MOUNT NORTH F

Rhode Island

- 6.0117 DISCHARGE CHARACTERISTICS OF HURRICANE BARRIER, EAST PASSAGE OF NARRAGANSETT BAY, RHODE ISLAND - HYDRAULIC MODEL INVESTIGATION
G.A. PICKERING, U.S. Army, Waterways Experiment Station
- 6.0297 FLOOD CHARACTERISTICS OF SMALL DRAINAGE BASINS IN RHODE ISLAND
C.G. JOHNSON, U.S. Dept. of the Interior, Geological Survey
- 8.0047 PROTECTION OF NARRAGANSETT BAY FROM HURRICANE SURGES
H.B. SIMMONS, U.S. Army, Waterways Experiment Station
- 8.0126 ANALYTICAL PHYSICAL MODEL
F.M. WHITE, Univ. of Rhode Island, School of Engineering

Rio Grande Depression

- 9.0040 SOCORRO 2 DEGREE QUADRANGLE - NEW MEXICO
G.O. BACHMAN, U.S. Dept. of the Interior, Geological Survey

Rocky Mountains

- 1.0011 WATER YIELD IMPROVEMENT AND AVALANCHE HAZARD PREDICTION IN ALPINE AREAS OF THE ROCKY MOUNTAINS
M. MARTINELLI, Colorado State University, U.S.D.A. Rocky Mtn. For. Sta.

Rogue River

- 3.0267 LOST CREEK LAKE PROJECT, ROGUE RIVER, OREGON
UNKNOWN, U.S. Army, Engineer District

Salmon River

- 6.0080 A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS - REPORT ON FLOOD CONTROL SUBPROJECT - IDAHO
J.J. PEEBLES, Univ. of Idaho, Water Resources Research Inst.

San Andreas Rift

- 3.0019 ENGINEERING SEISMOLOGY

3.0108 REGIONAL GEOLOGICAL FRAMEWORK, NORTH CENTRAL SAN ANDREAS FAULT - CALIFORNIA

- F.E. BRABB*, U.S. Dept. of the Interior, Geological Survey
- 3.0111 SAN ANDREAS FAULT - CALIFORNIA COOP
M.M. CLARK, U.S. Dept. of the Interior, Geological Survey
- 3.0112 SOUTHERN CALIFORNIA TECTONICS
M.M. CLARK, U.S. Dept. of the Interior, Geological Survey
- 3.0113 REGIONAL TECTONIC ANALYSIS - SAN ANDREAS FAULT - INVESTIGATION OF BORRIGO MOUNTAIN EARTHQUAKE, APRIL 8, 1968 - CALIFORNIA (ABBREV)
M.M. CLARK, U.S. Dept. of the Interior, Geological Survey
- 3.0117 INSTRUMENTAL STRAIN - CALIFORNIA AND NEVADA
M.J. JOHNSTON, U.S. Dept. of the Interior, Geological Survey
- 3.0120 MONTEREY-POINT REYES (EARTHQUAKE) - CALIFORNIA
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- 3.0129 AUTOMATIC MICROEARTHQUAKE PROCESSING - CALIFORNIA
S.W. STEWART, U.S. Dept. of the Interior, Geological Survey
- 3.0130 SEISMIC SOURCE STUDIES - CALIFORNIA
W. THATCHER, U.S. Dept. of the Interior, Geological Survey
- 3.0133 TECTONICS OF ACTIVE FAULTS - CALIFORNIA AND NEVADA
R.E. WALLACE, U.S. Dept. of the Interior, Geological Survey
- 3.0134 CALIFORNIA M/EQ NET
R.L. IYESSON, U.S. Dept. of the Interior, Geological Survey
- 3.0138 STUDY OF MECHANISM OF ACCUMULATION AND RELEASE OF TECTONIC STRESS IN CENTRAL CALIFORNIA
A. NUR, Stanford University, School of Earth Sciences
- 3.0139 CALTECH SEISMIC NETWORK AND SAN FERNANDO EARTHQUAKE STUDIES
C.R. ALLEN, Calif. Inst. of Technology, Graduate School
- 3.0156 ACTIVE DISPLACEMENT ON THE CALAVERAS FAULT ZONE AT HOLISTER, CALIFORNIA
T.H. ROGERS, U.S. Dept. of Commerce, Earthquake Mechanism Lab.
- 3.0173 EARTHQUAKES AND ACTIVE FAULTS
J.S. DODD, U.S. Dept. of the Interior, Bureau of Reclamation
- 3.0180 TECTONIC ANALYSIS OF SEISMICALLY ACTIVE ZONES IN NEVADA, IN SUPPORT OF EARTHQUAKE CONTROL EXPERIMENT - CALIFORNIA, NEVADA, UTAH
P.P. ORKILD, U.S. Dept. of the Interior, Geological Survey
- 9.0001 REGIONAL GEOLOGIC FRAMEWORK - SAN ANDREAS FAULT - CALIFORNIA
T.W. DIBBLEE, U.S. Dept. of the Interior, Geological Survey

San Fernando Valley

BEHAVIOR OF UNDERGROUND BOX CON-
CRETE IN THE SAN FERNANDO EARTHQUAKE OF
FEBRUARY 1971

ADLER, U.S. Army, Engineer District

VAN NORMAN RESERVOIRS AREA, CALIFOR-

ERKES, U.S. Dept. of the Interior, Geological Survey

THE SAN FERNANDO EARTHQUAKE SOILS
GEOLOGIC INVESTIGATIONS IN RELATION
TO HIGHWAY DAMAGE

RYSOCK, State Materials & Res. Dept.

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LLDREDGE, U.S. Dept. of Commerce, Environ.
Research Laboratories

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CCLORE, U.S. Dept. of Hou. & Urb. Dev., Off. of
Housing & Res.

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3.0098 ANALYTICAL INVESTIGATIONS OF THE
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W. TSENG, Univ. of California, Earthquake Engin. Res. Ctr.

3.0101 RECOMMENDATIONS DEVELOPED FROM RE-
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UNKNOWN, Los Angeles Co. Bd. of Suprvs.

3.0102 OPTIMIZATION OF WATER RESOURCE
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C.M. DUKE, Univ. of California, School of Engineering

3.0139 CALTECH SEISMIC NETWORK AND SAN FER-
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C.R. ALLEN, Calif. Inst. of Technology, Graduate School

3.0145 STRAINS AND TILTS ASSOCIATED WITH THE
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P. JUNGEIS, Calif. Inst. of Technology, Seismological
Laboratory

3.0148 ANALYSIS OF THE EARTHQUAKE RESPONSE
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J.H. WOOD, Calif. Inst. of Technology, Earthquake Engin.
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3.0151 THE SAN FERNANDO EARTHQUAKE OF
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3.0244 PREDICTED SAN FERNANDO EARTHQUAKE
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J.R. MURPHY, Environmental Res. Corporation

9.0029 GEOLOGY OF THE POINT DUME QUADRAN-
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R.H. CAMPBELL, U.S. Dept. of the Interior, Geological Sur-
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San Francisco Bay

3.0109 ENVIRONMENTAL GEOLOGY OF THE SAN
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E.E. BRABB, U.S. Dept. of the Interior, Geological Survey

3.0118 ENGINEERING SEISMOLOGY - CALIFORNIA

W.B. JOYNER, U.S. Dept. of the Interior, Geological Survey

3.0159 ENG AFTERSHOCK STUDIES - CALIFORNIA

S.T. ALGERMISSEN, U.S. Dept. of Commerce, Environ.
Research Laboratories

3.0161 A STUDY OF EARTHQUAKE LOSSES IN THE
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UNKNOWN, U.S. Dept. of Commerce, Environ. Research
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6.0298 USE OF ERTS-1 DATA - SUMMARY REPORT OF
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F.J. THOMSON, Environmental Res. Inst. Mich.

- 16.0054 ENVIRONMENTAL PLANNING AND GEOLOGY - PROCEEDINGS OF THE SYMPOSIUM ON ENGINEERING GEOLOGY IN THE URBAN ENVIRONMENT

D.R. NICHOLS, U.S. Dept. of the Interior, Geological Survey

- 16.0055 GEOLOGIC ENVIRONMENTAL MAPS FOR LAND-USE PLANNING, CALIFORNIA

E.H. PAMPEYAN, U.S. Dept. of the Interior, Geological Survey

- 16.0056 SOIL ENGINEERING RESEARCH - CALIFORNIA

F.L. YOUNG, U.S. Dept. of the Interior, Geological Survey

- 16.0075 PROGRAM DESIGN 1971 - SAN FRANCISCO BAY REGION ENVIRONMENT AND RESOURCES PLANNING STUDY

UNKNOWN, U.S. Dept. of the Interior, Geological Survey

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- 10.0019 LAND SUBSIDENCE STUDIES IN THE SAN JOAQUIN VALLEY - CALIFORNIA

J.F. POLAND, U.S. Dept. of the Interior, Geological Survey

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- 1.0008 DEVELOPMENT OF METHODOLOGY FOR EVALUATION AND PREDICTION OF AVALANCHE HAZARD IN THE SAN JUAN MOUNTAINS OF COLORADO

J.D. IVES, Univ. of Colorado, Inst. of Arctic & Alpine Res.

San Pablo Bay

- 6.0178 NORTH RICHMOND - SAN PABLO BAY AREA STUDY - CALIFORNIA

J.P. KENNY, Council on Intergov. Relations

Sangamon River

- 6.0086 OAKLEY-SANGAMON REMOTE SENSING ENVIRONMENTAL RESEARCH PROGRAM - ILLINOIS

H.M. KARARA, Univ. of Illinois, School of Engineering

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- 6.0039 EFFECTS OF URBAN DEVELOPMENT AND WATER USE ON THE SANTA ANA RIVER, CALIFORNIA

M.W. BUSBY, U.S. Dept. of the Interior, Geological Survey

- 6.0172 SANTA ANA RIVER BASIN, FLOOD CONTROL PROJECT, EAST TWIN AND WARM CREEK IMPROVEMENT

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- 9.0034 MALIBU BEACH QUADRANGLE AND THE UNINCORPORATED PART OF THE TOPANGA QUADRANGLE, LOS ANGELES COUNTY COOPERATIVE, CALIFORNIA

R.F. YERKES, U.S. Dept. of the Interior, Geological Survey

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- 3.0276 REGIONAL SEISMICITY AND TECTONICS OF THE SOUTHERN INTERMOUNTAIN SEISMIC BELT WITH EMPHASIS ON THE WASATCH FRONT - UTAH

S.H. WARD, Univ. of Utah, School of Mines

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- 3.0111 SAN ADREAS FAULT - CALIFORNIA COOP

M.M. CLARK, U.S. Dept. of the Interior, Geological Survey

- 5.0005 GUIDES FOR FUEL BREAKS IN THE SIERRA NEVADA MIXED-CONIFER TYPE

L.R. GREEN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta.

- 5.0040 FOREST FIRE METEOROLOGY IN THE PACIFIC COASTAL REGION

M.J. SCHROEDER, U.S. Dept. of Agriculture, Pac. S.W. For. & Rg. Expt. Sta.

Silver Valley

- 6.0003 SILVER VALLEY FLOOD - SOCIAL PSYCHOLOGICAL EFFECTS

C.D. HARVEY, Boise State College, School of Arts

Skagit River

- 11.0007 PHYSICAL EVALUATION OF CLOUD SEEDING TECHNIQUES FOR MODIFYING OROGRAPHIC SNOWFALL - THE CASCADE PROJECT

P.V. HOBBS, Univ. of Washington, School of Arts

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- 6.0404 FLOOD PROFILES AND INUNDATED AREAS ALONG THE SKOKOMISH RIVER, WASHINGTON

J.E. CUMMANS, U.S. Dept. of the Interior, Geological Survey

Snake River

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ept. of the Interior, Geological Survey
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Army, Corps of Engineers
VER BASIN, PART F - SOUTHERN
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t. of the Interior, Geological Survey

Souris River

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ept. of the Interior, Geological Survey
G PLAN FOR FIRE WEATHER SER-
H CAROLINA
Dept. of Commerce, Natl. Weather Ser-

URANCE STUDY
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INA
Dept. of Agriculture, Soil Conservation

TION AND ANALYSIS OF FLOODS
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E, U.S. Dept. of the Interior, Geological

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T PLAN
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AIN INUNDATION
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6.0197 HOLLOW CREEK WATERSHED PROJECT,
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UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
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MYRTLE BEACH

6.0363 MYRTLE BEACH, S.C. - COMPREHENSIVE
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UNKNOWN, State Planning & Grants Div.

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6.0197 HOLLOW CREEK WATERSHED PROJECT,
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UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
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South Dakota

4.0004 GEOLOGY OF THE RAPID CITY AREA, SOUTH
DAKOTA
J.M. CATTERMOLE, U.S. Dept. of the Interior, Geological
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4.0007 STABILIZATION OF EXPANSIVE CLAYS AND
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R.D. RICHMOND, U.S. Dept. of the Interior, Bureau of
Reclamation

6.0056 BLACK HILLS FLOOD OF JUNE 9, 1972
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & At-
mos. Admin.

6.0196 UNION CREEK WATERSHED PROJECT, SOUTH
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UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation
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6.0219 INVESTIGATION AND ANALYSIS OF FLOOD
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UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0366 INVESTIGATION AND ANALYSIS OF FLOOD
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UNKNOWN, U.S. Dept. of the Interior, Geological Survey

9.0022 LANDSLIDE STUDIES IN SOUTH DAKOTA - RE-
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C.L. KEENER, Unknown Inst. or Indiv. Grant

16.0020 TRAINING PROGRAM FOR CRISIS INTER-
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UNKNOWN, Western Health Systems Inc.

16.0086 ROLE PERFORMANCE IN THE OPERATING

16.0002 CONSULTATIVE PSYCHIATRIC SERVICES TO INDIVIDUALS AND COMMUNITY GROUPS AND AGENCIES IN RAPID CITY, SOUTH DAKOTA
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6.0196 UNION CREEK WATERSHED PROJECT, SOUTH DAKOTA
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

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3.0202 A STUDY OF MICROEARTHQUAKES IN THE SOUTHEASTERN UNITED STATES
I.T. LONG, Georgia Inst. of Technology, School of Geosciences

3.0277 SEISMICITY STUDIES OF THE CENTRAL APALACHIAN REGION
G.A. BOLLINGER, Virginia Polytechnic Institute, School of Arts

Southern United States

5.0042 DEVELOPMENT OF IMPROVED TECHNIQUES FOR USING PRESCRIBED FIRE IN SOUTHERN FORESTS
R.W. COOPER, U.S. Dept. of Agriculture, S.E. Forest Experiment Station

8.0015 HURRICANE CELIA REDEVELOPMENT
UNKNOWN, U.S. Coastal Bend Reg. Comm.

Southwest United States

5.0002 PRESCRIBED FIRE TECHNOLOGY FOR THE SOUTHWEST
A.W. LINDENMUTH, Northern Ariz. University, U.S.D.A. Rky. Mtn. Forest Sta.

6.0041 FLOOD AND SEDIMENT REDUCTION IN STEEP UNSTABLE BRUSHLANDS OF THE SOUTHWEST
R.M. RICE, U.S. Dept. of Agriculture, Pac. S.W. For. & Rg. Exp. Sta.

St. Lawrence River

6.0130 REGIONAL COMPREHENSIVE MULTI-PURPOSE WATER RESOURCES PLANNING STUDIES IN NEW YORK
J.A. FINCK, State Dept. of Env. Conserv.

6.0143 TEST OF THE ERTS-DATA COLLECTION SYSTEM IN THE SUSQUEHANNA RIVER BASIN
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0337 APPLICATION OF LUNR SYSTEM TO FLOOD PLAIN ANALYSIS AND MANAGEMENT IN THE SUSQUEHANNA RIVER BASIN
J.W. KELLEY, State University of New York, Agricultural Experiment Sta.

8.0135 OPERATION AGNES
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Tampa Bay

6.0071 ESTUARINE HYDROLOGY OF TAMPA BAY
C.R. GOODWIN, U.S. Dept. of the Interior, Geological Survey

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6.0053 CHENA RIVER LAKES PROJECT, ALASKA - PROBLEMS RELATING TO CHANNEL DEVELOPMENT, EROSION, & BANK & LEVEE PROTECTION
C.P. LINDNER, U.S. Army, Corps of Engineers

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2.0024 METEOROLOGICAL DROUGHT IN TENNESSEE
J.V. VAIKSNORAS, U.S. Dept. of Commerce, Natl. Weather Service

3.0174 NEW MADRID EARTHQUAKE - ARKANSAS, ILLINOIS, KENTUCKY, MISSISSIPPI, MISSOURI AND TENNESSEE
M.F. KANE, U.S. Dept. of the Interior, Geological Survey

3.0236 A MICROEARTHQUAKE STUDY OF THE LOWER MISSISSIPPI VALLEY - ARKANSAS, MISSISSIPPI AND TENNESSEE
O.W. NUTTLI, St. Louis University, Graduate School

3.0269 EARTHQUAKE RISK EVALUATION - CRITTENDEN COUNTY, ARKANSAS, DESOTO COUNTY, MISSISSIPPI, AND SHELBY COUNTY, TENNESSEE
F. KELLOGG, Mississippi Ark. Tenn. Council

3.0270 REGIONAL EARTHQUAKE RISK STUDY - MISSOURI, ARKANSAS, KENTUCKY, TENNESSEE, MISSISSIPPI AREA
UNKNOWN, Mississippi Ark. Tenn. Council

6.0055 HURRICANE CREEK WATERSHED PROJECT, HUMPHREYS AND DICKSON COUNTIES, TENNESSEE
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

6.0147 FLOOD INVESTIGATIONS - TENNESSEE
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

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 W.W. U.S. Dept. of the Interior, Geological Survey

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DICKSON COUNTY

HURRICANE CREEK WATERSHED PROJECT, HUMPHREYS AND DICKSON COUNTIES, TENNESSEE
 W.W. U.S. Dept. of Agriculture, Soil Conservation Service

HENDERSON COUNTY

HURRICANE CREEK WATERSHED PROJECT - TENNESSEE
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HUMPHREYS COUNTY

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SEE
 UNKNOWN, State Planning Commission

NASHVILLE

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NASHVILLE COUNTY

- 6.0370 FLOODING OF SMALL STREAMS IN NASHVILLE-DAVIDSON COUNTY AREA, TENNESSEE
 W.W. CONN, U.S. Dept. of the Interior, Geological Survey

Tennessee River

- 6.0367 DEVELOPMENT OF WATER RESOURCE MANAGEMENT METHODS - TENNESSEE
 W.W. LESIGNE, U.S. Tennessee Valley Auth., Div. of Water Cont. Plan

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- 2.0008 PROJECT ARID DROP, A SUMMARY REPORT OF CLOUD SEEDING ACTIVITIES IN ARIZONA AS CONDUCTED BY ATMOSPHERICS INCORPORATED (ABBREVIATED)
 W.W. HENDERSON, Atmospherics Incorporated
- 3.0125 SPECIAL MICROEARTHQUAKE NETWORKS - ALABAMA AND TEXAS
 W.W. ROLLER, U.S. Dept. of the Interior, Geological Survey
- 5.0022 EFFECT OF PRESCRIBED BURNING ON WATER YIELD AND QUALITY FROM BRUSH INFESTED LANDS - TEXAS
 W.W. BRIGHT, Texas Technological University, School of Agriculture
- 6.0061 PROGRAM FOR HYDROLOGIC INVESTIGATION OF SMALL DRAINAGE AREAS IN TEXAS
 W.W. SCHROEDER, U.S. Dept. of the Interior, Geological Survey
- 6.0100 RED RIVER EMERGENCY BANK PROTECTION, LOUISIANA, ARKANSAS, AND TEXAS
 UNKNOWN, U.S. Army, Engineer District
- 6.0148 COMPREHENSIVE PLAN, CITY OF HAMILTON, TEXAS
 UNKNOWN, State Div. of Comp. Planning
- 6.0149 HYDROLOGIC INVESTIGATION OF SMALL DRAINAGE AREAS IN TEXAS
 UNKNOWN, U.S. Dept. of the Interior, Geological Survey

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D.R. BASCO, Texas A & M University System, School of Engineering
- 6.0152 PORT ARTHUR HURRICANE FLOOD PROTECTION, PORT ARTHUR AND VICINITY, TEXAS
UNKNOWN, U.S. Army, Engineer District
- 6.0201 CORNUDAS, NORTH AND CULP DRAWS WATERSHED, HUDSPETH COUNTY, TEXAS, AND OTERO COUNTY, NEW MEXICO
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0372 URBAN HYDROLOGY STUDY - AUSTIN, TEXAS
J.W. BOARD, U.S. Dept. of the Interior, Geological Survey
- 6.0373 URBAN HYDROLOGY STUDIES OF SELECTED AREAS IN TEXAS - DALLAS, AUSTIN
J.D. BOHN, U.S. Dept. of the Interior, Geological Survey
- 6.0374 EFFECTS OF URBANIZATION ON FLOODS IN THE DALLAS, TEXAS METROPOLITAN AREA
G.R. DEMPSTER, U.S. Dept. of the Interior, Geological Survey
- 6.0375 HYDROLOGIC STUDIES OF SMALL RURAL TEXAS WATERSHEDS
W.H. GOINES, U.S. Dept. of the Interior, Geological Survey
- 6.0376 EFFECTS OF URBANIZATION ON FLOODS IN THE HOUSTON, TEXAS METROPOLITAN AREA
S.L. JOHNSON, U.S. Dept. of the Interior, Geological Survey
- 6.0377 URBAN HYDROLOGY STUDY - SAN ANTONIO, TEXAS
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0379 WATER FOR TEXAS - URBAN WATER RESOURCES PLANNING AND MANAGEMENT - THE PROCEEDINGS OF THE ANNUAL CONFERENCE HELD AT SAN ANTONIO (ABBREV)
UNKNOWN, Texas A & M University System, Water Resources Institute
- 6.0380 OSO CREEK TECHNICAL ASSISTANCE STUDY - PRELIMINARY STUDY ON THE PROBLEMS AND OPPORTUNITIES FOR DEVELOPMENT OF OSO CREEK AND OSO BAY
UNKNOWN, U.S. Coastal Bend Reg. Comm.
- 6.0381 SOIL AND WATER CONSERVATION NEEDS INVENTORY, COOKE, GRAYSON AND FANNIN COUNTIES, TEXAS
UNKNOWN, Texas Regional Planning Comm.
- 6.0382 URBAN HYDROLOGY STUDY, DALLAS, TEXAS
G.R. DEMPSTER, U.S. Dept. of the Interior, Geological Survey
- 6.0383 URBAN HYDROLOGY STUDY - FORT WORTH, TEXAS
R.B. HAMPTON, U.S. Dept. of the Interior, Geological Survey
- 6.0384 URBAN HYDROLOGY STUDY - DALLAS COUNTY, TEXAS
B.C. MASSEY, U.S. Dept. of the Interior, Geological Survey
- 6.0385 PALACIOS COMPREHENSIVE PLAN - PHASE 2 - SUMMARY REPORT
G.L. WILLIAMS, Lockwood Andrews & Newman Inc.
- 6.0386 URBAN HYDROLOGY STUDY - HOUSTON, TEXAS
- 6.0387 VARIATION OF FLOOD RUNOFF WITH DURATION AND INTENSITY OF STORMS - TEXAS
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- 6.0388 RELATION OF CLIMATIC AND WATERSHED CHARACTERISTICS TO STORM RUNOFF IN THE EDWARDS PLATEAU - TEXAS
W.G. KNEISEL, U.S. Dept. of Agriculture, Blackland Experiment Watershed
- 6.0389 URBAN HYDROLOGY STUDY, SAN ANTONIO, TEXAS
R.D. STEGER, U.S. Dept. of the Interior, Geological Survey
- 8.0013 TEXAS COAST HURRICANE SURGE MODEL STUDIES
N.J. BROGDON, U.S. Army, Estuaries Division
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- 8.0039 GALVESTON BAY HURRICANE SURGE - REPORT 3 - EFFECTS OF BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV)
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- 8.0045 GALVESTON BAY HURRICANE SURGE - REPORT 1 - EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS (ABBREV)
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- 8.0046 GALVESTON BAY HURRICANE SURGE - REPORT (2) EFFECTS OF PROPOSED BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV)
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T.W. MILLHORN, Gulf Univ. Res. Consortium
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T.G. ABRAMS, Univ. of Texas, Ctr. For Highway Research
- 10.0001 COSTS OF LAND SUBSIDENCE IN THE HOUSTON-GALVESTON AREA, TEXAS
W.L. TROCK, Texas A & M University System, School of Agriculture
- 10.0011 LAND-SURFACE SUBSIDENCE, BAYTOWN AREA, TEXAS
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- 10.0012 LAND-SURFACE SUBSIDENCE, TEXAS CITY AND SEABROOK AREAS, TEXAS
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- 10.0013 CONTINUING QUANTITATIVE GROUNDWATER STUDIES IN THE HOUSTON DISTRICT
A.G. WINSLOW, U.S. Dept. of the Interior, Geological Survey
- 10.0032 CONTROL OF LAND SUBSIDENCE IN THE TEXAS GULF COAST AREA
A.P. DEFLACHE, Lamar University, School of Engineering

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AMES, U.S. Dept. of Commerce, Building Research

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ENTRY, U.S. Atomic Energy Commission, Los
Scientific Lab

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RNES, U.S. Dept. of Commerce, Environ. Research
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NOR, Texas Technological University, School of En-
gineering

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SON, Texas A & M University System, Graduate
School

INVESTIGATION OF SHORELINE CHANGES AT
GENT BEACH, TEXAS

EELIG, Texas A & M University System, Graduate
School

TEXAS BARRIER ISLANDS

INTER, U.S. Dept. of the Interior, Geological Survey

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OWN, Unknown Inst. or Indiv. Grant

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A
SHER, Univ. of Texas, Bureau of Economic Geology

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RIGHT, Texas Technological University, School of
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ARD, U.S. Dept. of the Interior, Geological Survey

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PUBLIC ASSISTANCE

SLAB AVALANCHE STUDIES, 1971-1972

ELLE, State Dept. of Highways, Olympia, 18501

Interim report of the second year of a three year avalanche hazards along Washington mountain presented. Applicable snow, avalanche and for 1971-72 are given. Also included are a treatment of the stress analysis of slab avalanches, a survey of snow clearing technology, and a survey of technology in Japan.

187p., NTIS No. PB-221 080/5; PC \$4.85 MF

SUPPORTED BY Washington State Government - Olympia

THE NORTH CASCADES HIGHWAY SR-20 AVALANCHE ATLAS

ELLE, Univ. of Washington, School of Arts, Seattle, 98105

Avalanche Atlas catalogs details of snow avalanche activity along the North Cascades Highway, SR-20, on the west side of the Cascade Mountains on the east side. Data was collected during winter reconnaissance in 1970 and 1971. The atlas is designed primarily as an operational guide for Department Maintenance personnel who will be involved in snow removal operations on SR-20.

177p., NTIS No. PD-220 336/2; PC \$3.00 MF

SUPPORTED BY Washington State Government - Olympia

DISASTER MITIGATION

AN GEOLOGY PLAN FOR CALIFORNIA - EFFECTS, MAGNITUDE, & COSTS OF GEOLOGIC DISASTERS AND RECOMMENDATIONS FOR THEIR MITIGATION (ABBREVIATED)

State Div. of Mines & Geology, Sacramento, 95814

Report recommends loss-reduction measures for problems which collectively threaten an estimated billion loss in California's urban areas from 1970 to 1980. The problems are earthquake shaking, loss of resources to urbanization, landsliding, flooding, erosion, expansive soils, fault displacement, volcanic hazards, and subsidence. The report describes the nature, distribution, and magnitude of each hazard as well as costs and effectiveness of possible loss-reduction measures, and agencies responsible for those measures.

111p., NTIS No. PB-222 447/5; PC \$7.75 MF

1.0004, ACOUSTIC EMISSION AND RELATED PROPERTIES OF SNOW APPLIED TO THE DETERMINATION OF SLAB AVALANCHE INITIATION 11042-EN

C.C. BRADLEY, Montana State University, School of Letters, Bozeman, Montana 59715 (DA-ARO(D)-31-124-73-G175)

Acoustic emissions have been detected from snow preceding avalanche release. Attempts will be made to determine whether they can be detected in time to serve as a warning of impending avalanches. Relevance - avalanches are a hazard to military operations, because previously inaccessible mountain areas, where avalanches occur frequently, are constantly being penetrated by new highways. Since the Army must be prepared to conduct operations in such regions both in the United States and on foreign soil, the need for a reliable means of predicting avalanches not only continues to exist, but is increasing.

A concerted attack will be made upon three related problems involved in slab avalanche release - (1) Laboratory and field investigation of the relevance of acoustic emission techniques to in-situ monitoring of snow slab, (2) Laboratory measurement of viscoelastic and failure properties of unconfined and confined snow, and (3) Laboratory and field study of the formation and strength of seasonal depth hoar.

Supporting agency address information: OCRD Army Research Office, Box CM, Duke Station, Durham, N.C. 27706

SUPPORTED BY U.S. Dept. of Defense - Army

1.0005, ACOUSTIC EMISSION AND RELATED PROPERTIES OF SNOW APPLIED TO THE DETERMINATION OF SLAB AVALANCHE INITIATION

C.C. BRADLEY, Montana State University, Graduate School, Bozeman, Montana 59715

This research is designed to provide a better understanding of snowpack release, especially as related to 'hard' avalanches, the most dangerous of all avalanches, which are characteristic of wind packed or metamorphosed snow slopes of high density and strongly bonded ice crystals. The research places great emphasis on laboratory and field assessment of acoustic emission techniques as a basis for making indirect observations of changing physical properties and events leading to snow avalanching. Acoustic emission instrumentation will provide in-situ monitoring of snow slabs. The research is coupled with laboratory evaluation of viscoelastic and failure properties of unconfined and confined mid-alpine snow under various conditions of loading as well as study of the formation and strength of seasonal depth hoar. The research is expected to give significant data on avalanche mechanics and hopefully will permit the prediction of potential avalanching. The work is being carried out with cooperative support from the Army Research Office - Durham.

SUPPORTED BY U.S. Natl. Science Foundation

1.0006, AVALANCHES ON THE NORTH CASCADES HIGHWAY (SR-20) - SUMMARY REPORT

ing. It is necessary to inventory the hazards and hazards, it was necessary to develop a control plan. Application of avalanche defense structures, procedures for clearance and control of operations are critical portions of the maintenance program. Several alternate operational levels with cost/benefit analysis are contained in the findings.

Pub. Sep 71: 74p., NTIS No. PB-220 337/0 PC \$3.00 MF \$0.95.

SUPPORTED BY Washington State Government - Olympia

HAZARD REDUCTION

1.0007, PUGET PEAK AVALANCHE, ALASKA

M.C. HOYER, Arizona State University, School of Liberal Arts, Tempe, Arizona 85281

Abstract: The Alaska earthquake of March 27, 1964, caused four phenomena at the head of Puget Bay in south-central Alaska. A large rock-snow avalanche fell from Puget Peak and slid into the bay. Sea waves struck the coast, transporting debris inland to elevations of 7 m. Tectonic warping uplifted Puget Bay 1.7 m, and earth cracks formed in the surficial valley alluvium. The Puget Peak avalanche transported 1.8 x 1,000,000 cu m of rock, snow, soil, and plant debris downslope. The avalanche began as a large rockfall of jointed and fractured bedrock from Puget Peak. The rockfall reached the cirque traveling at a speed of more than 100 kph; there, it set in motion a large volume of snow. Most of the debris was deposited on the beach and in the bay. Undisturbed 1963-1964 snow in the cirque, areas of undisturbed vegetation and soil, made fresh gorges and scars on bedrock surfaces, and large areas stripped of surficial vegetation and soil along the avalanche track indicate that the avalanche mass slid on snow, soil, and rock from the cirque to the bay. Evidence along the avalanche track indicates that the avalanche mass traveled at high speed along its entire extent.

Pub. Dec. 70: 32p., NTIS No. AD-733 142: Reprint.

SUPPORTED BY U.S. Dept. of Defense - Army

1.0008, DEVELOPMENT OF METHODOLOGY FOR EVALUATION AND PREDICTION OF AVALANCHE HAZARD IN THE SAN JUAN MOUNTAINS OF COLORADO

J.D. IVES, Univ. of Colorado, Inst. of Arctic & Alpine Res., Boulder, Colorado 80302

The development of a methodology for evaluation and prediction of avalanche hazard with particular emphasis on the San Juan Mountains of Colorado, but with general applicability to other areas.

SUPPORTED BY U.S. Dept. of Interior - Bn. Reclamation

1.0009, THERMAL SURVEILLANCE OF ACTIVE VOLCANOES

J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

Abstract: The author has identified the following significant results. By the end of 1973, aerial infrared scanner traverses for thermal anomaly recordings of all Cascade Range volcanoes were essentially completed. Amplitude level slices of

and warm ground, it is largely a periglacial feature. The development of sizable glacier periglacial features. The ongoing radiative flux from the east breach anomalies is sufficient to account for the volume of ice melted to form the glacier perforations. DCP station 6251 has been monitoring a thermally anomalous area in the north slope of Mount Baker. The present thermal activity of Mount Baker accords for continuing hydrothermal alteration in the crater south of the main summit and recurrent debris avalanches from Sherman Peak on its south rim. The infrared anomalies mapped as part of the experiment SR 251 are considered the base evidence of the subglacial heating which was the probable triggering mechanism of an avalanche down Boulder Glacier on August 20-21, 1973.

Pub. Jan 74: 4p., NTIS No. E74-10418: PC \$4.00 MF \$1.45

SUPPORTED BY U.S. Natl. Aero. & Space Admin.

1.0010, SURFICIAL GEOLOGY OF JUNEAU AND VICINITY URBAN AREA, ALASKA

R.D. MILLER, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

The Inman project started as part of a coastal community program of earthquake hazard studies following the March 1964 Alaska earthquake. The original primary objective was to investigate and evaluate potential hazards for earthquakes as a result of the geologic setting. The study has been broadened to include other natural geologic events and to try and relate man's use of the land to the existing geologic environmental conditions. Field mapping was completed in 1971.

The project consists of differentiating and mapping surficial deposits and performing physical properties tests on selected samples. Development of raised marine and glaciomarine deposits, glaciofluvial, glacial, and lacustrine deposits is coupled to the geologic history, which in part influences the different physical properties inherent in the materials. The availability and utilization of this information can help the planning and execution of urban expansion and industrial development to hopefully avoid geologic pitfalls by taking into account the geologic influence on the environment, such as relative stability of deposits in case of severe earthquakes, areas of known or potential rockfalls and avalanches, and differing foundation conditions.

A geologic map with text and interpretive transparent overlays was released to open file in May 1972. A U.S. Geological Survey Bulletin, 1394-C, was published in 1973 that gave the glaciomarine deposits a formation name, the Gastineau Channel Formation. A geologic map with tabular text is being processed for publication in the Miscellaneous Geologic Investigations Map series of the Geological Survey.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

1.0011, WATER YIELD IMPROVEMENT AND AVALANCHE HAZARD PREDICTION IN ALPINE AREAS OF THE ROCKY MOUNTAINS

M. MARTINELLI, Colorado State University, U.S.D.A. Rocky Mtn. For. Sta., Fort Collins, Colorado 80521 (RM1601)

Objective: Water yield improvement of alpine zones and improved avalanche hazard forecasting.

snowmelt. Techniques for stabilizing snow on steep slopes and for evaluating avalanche hazard do not exist. Determine relationships between meteorological terrain, and snowpack conditions and avalanche formation and movement.

Progress: There is little data on the amount of moisture lost to the atmosphere during blowing snow events. A mathematical model of sublimation losses from snow blowing over a horizontal surface showed the most important factors to be particle size and distribution, humidity, and temperature. At -20 degrees C., 90 percent relative humidity, and steady state conditions, sublimation was estimated to be 17 percent per minute. Fundamental questions still exist about humidity gradients, ventilation rate, particle composition, and particle fall velocity. It appears that appreciable water returns to the atmosphere during blowing snow events. Detonating cord was used to simulate the overpressure patterns caused by sonic booms to see if supersonic flights over snow covered mountains would cause avalanches. Simulated booms of 12 lbs./ft. overpressure released avalanches 3 out of 4 times when the snow was unstable. One of the avalanches had a fracture face of 107 inches. Although level flight produces overpressure of about 4 lbs./ft., maneuvers or terrain amplification could increase this by a factor of 3 or 4. The large storms of January 1971 and 1972 in the Cascade Mountains caused over 800 avalanches, four deaths, numerous injuries, and about three-fourths million dollars damage. The deaths and much of the property damage could have been avoided by proper zoning.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

1.0012, PHYSICAL PROPERTIES OF ALPINE SNOW AS RELATED TO WEATHER AND AVALANCHE CONDITIONS

M. MARTINELLI, U.S. Dept. of Agriculture, Rocky Mtn. For. & Rg. Ex. Sta., Fort Collins, Colorado 87101

Abstract: Data were taken in avalanche starting zones at an elevation of 11,700 feet in the Front Range of Colorado within 14 days of deposition. Densities varied from 40 to 450 kg/cubic meter. Snow with unusually high density for its age (initial hard slab), found in 15 percent of the pits, was correlated with moderate to high windspeeds, low temperatures, and presence of wind-transported snow. Tensile strength from a spin test varied from 1.0 to 1712 grams force/square cm. Strength increased with density but varied greatly for given densities. Younger snows tended to be weaker than older snows of the same density. Strength was also measured with shear box and shear vane. Ram resistance was higher for alpine snow than for snow of same density in trees. Air permeability was an order of magnitude less than expected and varied with the low flow rate used. Strength of snow of given density was greater for a certain permeability (texture) than for any other.

Pub. Jan. 71: 42p., NTIS No. PIJ-197 487. MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

1.0013, SNOW PACK STABILITY INDICES RELATIVE TO THE CLIMAX AVALANCHE

C.C. BRADLEY, Montana State University, School of Letters, Bozeman, Montana 59715

Abstract: The purpose of the research is to develop instruments, methods, theories, and indices which would permit

under stress emits acoustical signals and that these signals relate to the nature of the snow and the deforming force. Of particular interest is the fact that snow retains 'memory' of the kind and degree of stress it has undergone many hours after relaxation. Also of interest is that under certain kinds of stress the pattern of acoustical emission allows anticipation of the failure of the snow as much as 40 minutes in advance. Both of these findings have implications in terms of field analysis and safety. Two theories are presented: (a) a non-linear theory for snow deformation, (b) a theory of buckling as a potentially important mechanism for slab avalanche release.

Pub. Jul. 73: 23p., NTIS No. AD-765 500/4. PC \$2.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

1.0014, AVALANCHE CONTROL IMPLEMENTATION STUDY

L. LACHAPPELLE, State Dept. of Highways, Olympia, Washington 98501 (2R-40233508)

The objective of this project is to provide immediate and complete avalanche hazard identification and control on all Cascade Mountain passes. A training program for avalanche hazard forecasts and snow avalanche observers is established. This project is the implementation phase of the research project 'Methods of Avalanche Control on Washington Mountain Highways'. The pilot implementation program is being run on Stevens Pass, Snoqualmie Pass and the North Cascades Highway.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

2. DROUGHTS

PUBLIC ASSISTANCE

2.0001, STUDY OF SEAWATER DESALTING AS EMERGENCY WATER SUPPLY FOR NEW YORK CITY

S.L. SCHEFFER, Parsons Jordan Corporation, New York, New York

Abstract: The report concerns an investigation of the preliminary feasibility and cost of supplying 20 percent of the nominal water demand of a typical borough of the City of New York during periods of prolonged drought of the kind experienced in the mid-sixties. Multi-stage flash (MSF) desalting modules of 5, 10 and 25 MGD capacities were assumed for application in modular array to provide emergency borough needs for pure water up to 125 MGD in capacity for a single plant site. The specific plant studied was assumed to be located on an artificial island constructed one mile off Rockaway Beach. Extensive cost data are provided.

Pub. Ja. 70: 310p., NTIS No. PB-201 036. PC-GPO MF \$0.95. NTIS.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

J.T. ALFORD, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, loss of mineral resources to urbanization, landsliding, flooding, erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of possible loss-reduction measures, and agencies responsible for these measures.

Pub. Jan 73. 111p., NTIS No. PB-222 447/5; PC \$7.75 MF 1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

2.0003, CENTRAL FLORIDA SEEDING PROJECT

J.D. MCFADDEN, U.S. Dept. of Commerce, Research Flight Facility, Miami, Florida 33148

Abstract: A plan is presented which attempts to mitigate the drought through the seeding of clouds over Lake Okeechobee drainage basin during April and May 1971.

Pub. Mar. 71: 13p., NTIS No. COM-71-00558; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - NOAA.

2.0004, STUDIES OF URBAN EFFECTS ON RAINFALL AND SEVERE WEATHER

S.A. CHANGNON, Univ. of Illinois, State Water Survey Division, Urbana, Illinois 61802

Project METROMEX is a 5-year coordinated group effort now going into its third year which is studying the urban weather modification in the St. Louis area. The goal is to isolate and develop quantitative relationships for the processes whereby urban and industrial areas affect their regional climate. It is anticipated that many results of this project will be in a form that makes them transferable to other regions, although some future tests of this transferability will no doubt be necessary. More specifically, the results should point the way toward the development of future environmental consequences of alternative urban and other land use patterns. The results of METROMEX, when extended in larger areas, will have application to drought alleviation, siting of large wind power and solar energy devices, planned purposeful climatic modification, and possibly to severe storm alleviation.

This particular research will use radar and ground network data to delineate the urban-produced alterations in precipitation frequency and quantity and in severe local storms.

SUPPORTED BY U.S. Natl. Science Foundation

2.0005, JOINT FEDERAL-STATE CUMULUS SEEDING PROGRAM FOR MITIGATION OF 1971 SOUTH FLORIDA DROUGHT

J. SIMPSON, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Rockville, Maryland 20852

Abstract: A serious drought in the spring of 1971 occurred in South Florida. Two of the NOAA Research Flight Facility

and also the upland towers of each previously seeded complex.

Pub. 1972: 13p., NTIS No. COM-73-10656; Reprint SUPPORTED BY U.S. Dept. of Commerce - NOAA

2.0006, OKLAHOMA DROUGHT RELIEF OPERATIONAL PROGRAM (ODROP)

J.I. SUTHERLAND, Weather Sciences Incorporated, Norman, Oklahoma 73069

Abstract: Cloud seeding was conducted in drought-stricken areas of Oklahoma during the two month period beginning 15 August 1971 to augment precipitation. Over 175 clouds were seeded with about 42,000 pounds of silver iodide released pyrotechnically by aircraft at cloud base. Not more than three aircraft were used for the silver iodide seeding. The analysis of digitized radar data has indicated that the seeding-related rainfall amount on 11 of the 19 seeding days was about 50,000 acre feet or 16 billion gallons.

Pub. Dec. 71: 47p., NTIS No. PB-207 043; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Bureau of Reclamation

2.0007, HYDROLOGIC SYSTEMS MODELING AND SIMULATION

G. ARON, Penn. State University, Inst. Res. Land & Water Resour., University Park, Pennsylvania 16802

The objective of this project is to simulate selected hydrologic processes which are known to cause damages to land, vegetation and structures, for the purpose of developing practical solutions and measures to alleviate these damages. In the forefront of the hydrologic processes are floods and droughts. Mathematical models are being developed to simulate storm runoff, and applied to urban areas which have experienced flood problems in the past. In collaboration with students and municipal engineers as well as planners, devices or methods are being devised to reduce or delay the storm runoff and/or increase flow carried by existing storm sewers. A developed drought prediction model will be applied to various drought flow data for further confirmation and calibration.

SUPPORTED BY Pennsylvania State University

HAZARD REDUCTION

2.0008, PROJECT ARID DROP, A SUMMARY REPORT OF CLOUD SEEDING ACTIVITIES IN ARIZONA AS CONDUCTED BY ATMOSPHERICS INCORPORATED (ABSTRACT)

T.J. HENDERSON, Atmospherics Incorporated, Fresno, California

Abstract: Project Arid Drop was organized and directed by the Bureau of Reclamation to alleviate arid conditions over broad areas of Texas, Arizona and Oklahoma. The portion of the project outlined in this report is a summary of Atmospherics Incorporated in aerial application of silver iodide to convective cumulus developments. Accomplished during the period July 16 through August 12, 1971, these cloud seeding efforts were coordinated with the flight and radar activities of Meteorology Research based at Flagstaff, plus the

the ground now produced only virga or no precipitation. Further observations indicated proper treatment of cumulus clouds initiated precipitation, and enhanced the total rainfall from clouds where precipitation was already in progress.

Pub. Oct 71: 19p., NTIS No. PB-204 604: PC \$3.00 MF \$0.95.
SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

2.0009, HYGROSCOPIC SEEDING IN OKLAHOMA - VOLUME I

P.B. MACCREADY, Flight Test Research Inc., Long Beach, California

Abstract: In July 1971, because of apparent drought in southwest Oklahoma, a rainfall augmentation program was organized under the direction of the Division of Atmospheric Water Resources Management of the Bureau of Reclamation with funding provided by the Federal Office of Emergency Preparedness. The hygroscopic seeding project part of the overall program is discussed. Seeding flights were accomplished on 10 days during the period from mid-August to early October, with a record wet September for Oklahoma. There is no way to make a valid evaluation of the success of this operational program. The program is described and many of the concepts and factors behind hygroscopic seeding are examined.

Pub. Oct 71: 45p., NTIS No. PB-205 361: PC \$3.00 MF \$0.95.
SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

2.0010, FLORIDA CUMULUS SEEDING EXPERIMENT FOR DROUGHT MITIGATION, APRIL-MAY 1971

W.L. WOODLEY, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302

Abstract: As a result of the drought in south Florida in the spring of 1971, The Experimental Meteorology Laboratory (EML) undertook a dynamic cumulus seeding program in two target areas, one to the north and the other to the south of Lake Okeechobee. In the 61-day operational period from 1 April - 31 May, flights were conducted on 16 days, with actual seeding on 14 days. Real time runs of the EML one-dimensional cumulus model on the 1200 GMT Miami radiosonde eliminated 38 days as unseedable; seven additional seed days might have been obtained had a back-up seeder aircraft been available. Altogether, 2066 50-gm AgI flares were dropped into 196 clouds or cloud complexes. Altogether, seeded clouds produced about 180,000 acre-feet of rain. Conservative estimates ascribe about 100,000 acre-feet to seeding, leading to a benefit-to-cost ratio for the program exceeding thirty-to-one.

Pub. Nov 71: 166 p., NTIS No. COM-72-110149: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

2.0011, DROUGHT CLIMATOLOGY OF ILLINOIS

F.A. HUFF, State Water Survey, Chicago, Illinois 60601

Abstract: Analyses of the frequency distribution of droughts for periods of 3 to 60 months indicate that the relative severity is greatest in the southeastern, extreme southern and southwestern regions of the state. Severe droughts having durations exceeding 24 months are infrequent in Illinois. In general, the regions of greatest drought severity are elongated

from the 1900-55 study period occurred in the 1930's. A major drought-free period extended from 1943 through 1951. For droughts of 3, 6, 12, and 24 months, there is a 50 percent probability that another drought of the same duration will occur somewhere in Illinois within about 30 months after a similar drought has terminated.

Pub. 1963: 74p., NTIS No. PB-220 413/9: PC \$5.75 MF \$0.95.
SUPPORTED BY Illinois State Government - Springfield

2.0012, POTENTIAL OF PRECIPITATION MODIFICATION IN MODERATE TO SEVERE DROUGHTS

F.A. HUFF, State Water Survey, Urbana, Illinois 61801

Abstract: An investigation was made of the potential of precipitation modification in moderate to severe droughts in Illinois to alleviate water shortages in such critical periods. The study involved time and space analyses of the natural precipitation distribution and consisted of two phases. The first involved analyses of monthly precipitation characteristics in major 12-month and 24-month droughts in the 50-year period, 1906-55. The second phase was concerned with a detailed study of storm characteristics in the 1953-54 drought, one of the worst on record in Illinois. Results indicated that conditions occasionally prevail in some moderate to severe droughts during which successful cloud seeding might provide temporary relief over portions of an extensive drought region, especially with respect to providing agricultural relief. Potential for increasing municipal water supplies in the more severe drought conditions appear doubtful.

Pub. May 73: 32p., NTIS No. PB-228 817/3: PC \$4.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

2.0013, DROUGHT IN KANSAS

M.J. BROWN, Kansas State University, Agricultural Experiment Sta., Manhattan, Kansas 66502

Abstract: The duration and intensity of meteorological droughts, as determined by the Palmer Drought Index (PDI), are reported for the nine crop districts of Kansas for 1931 through 1968. Results of the analysis can be used to determine dry and wet period expectancies, land use capabilities, and drought disaster areas. Summaries of overall moisture conditions are presented for each district for each month in the time period covered. Month to month variables and months of drought are indexed and tabulated. The beginning and ending dates, the maximum severity, and the number of months of drought are listed for each period. The percentage frequency of the various classes of drought (established by the PDI) are indicated for each climatological division. These climatological divisions correspond directly to the nine crop districts.

Pub. Mar. 71: 14p., NTIS No. COM-72-11021: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

2.0014, BEACHES AND GROUND WATER OF CAPE SABLE, FLORIDA, DURING EXTREME DROUGHT

R.J. RUSSELL, Louisiana State Univ. Systems, Coastal Studies Institute, Baton Rouge, Louisiana 70803

Abstract: In October 1969 beaches and water tables were investigated after 5 months of adequate rainfall in the Cape

1969) or various local storms. Slabs of the eroded beach rock were tossed up on the beaches, and if sufficiently indurated became incorporated into the deposits. No evidence of subsequent cementation was observed. On East and Northwest capes the ground water had been replaced by stagnant seawater. On Middle Cape the water table was lowered, but a salinity gradient and some potable ground water were present in 1971. The Cape Sable region is isolated from mainland surface runoff by extensive areas of lakes and waterways with seawater salinities, and from subsurface flow of ground water by a thick section of compact marl and compressed peat. Accumulation of ground water depends on local rainfall, and its volume varies with size and permeability of catchment areas. The conclusions of this study are applicable to many other coastal areas and may be useful in assessing their population and survival potentialities.

Pub Aug 71: 27p., NTIS No. AD-731 381, PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept of Defense - Navy

2.0015. SEVERITY AND FREQUENCY OF DROUGHT IN MISSISSIPPI

J.C. MCWHORTER, Mississippi St University, School of Agriculture, State College, Mississippi 39762

This project will develop a monthly water balance for six geographic and soil areas in Mississippi for the period 1943-1972. Moisture excesses and deficiencies will be determined; and then, the beginning and ending of drought periods will be observed. These periods will be classified according to degree of severity in order to secure the frequency of occurrence of a given drought.

Weather stations which are representative of each study area will be selected. Monthly temperature and precipitation values for each area will be determined from climatological records and values will be calculated for each area which represent the available water capacity in the root zone. Computer programs will be developed which use the above data to seek the severity and frequency of drought in Mississippi.

SUPPORTED BY U.S. Dept of Interior - O. Wtr. Res. Res.

2.0016. NEBRASKA DROUGHTS - A STUDY OF THEIR PAST CHRONOLOGICAL AND SPATIAL EXTENT WITH IMPLICATIONS FOR THE FUTURE

M.P. LAWSON, Univ. of Nebraska, School of Arts, Lincoln, Nebraska 68508

Abstract: The purpose of the report is to measure the spatial and temporal dimensions of drought occurrence in Nebraska. Such interpretations were facilitated by the computer generation of 468 maps showing monthly values of drought in Nebraska, from 1931 through 1969. While it was found that the frequency of consecutive drought is least in the central portion of the state, the intensity of drought is greatest in this region. Maps of correspondence which relate the areal correlation between rural population density and precipitation also indicate high positive relationships for central Nebraska. Interpretation of tree ring growth values using moving t-test plots did not demonstrate the cyclical recurrence of drought. A short review was conducted as to the economic and climatic impact of irrigation on future droughts in Nebraska.

Pub Jul 71: 150p., NTIS No. PB-214 093/7, PC \$3.00 MF \$0.95.

Objective: Provide a comprehensive analysis of resource use in the Central Lahontan Basin under present and projected conditions by relating economic data and interpretations with physical data so that planning and development of resources may proceed on a more sound basis. Specific goals are: identification and description of present economic activity in the basin and its relation to land and water resources; evaluate the economic impact of factors such as improved agricultural technology, expansion of markets, and shifting resources from agriculture to other uses; evaluate the economic consequence of drought and flooding; identify and evaluate changes in land and water use patterns needed for more efficient use of resources and identify developments to meet projected needs; and identify and appraise major problems in the attainment of desirable patterns of use, management, and development of land and water resources.

Approach: Identify present level of resource use, resource development, and economic activity. Make population projections and project needs for output from resource use. Identify means of meeting future needs through resource use and development. Evaluate the economic consequence of alternative resource use and development decisions. Analytical techniques used include linear programming, budgeting, amortization, and standard statistical analysis of data.

Progress: Subbasin analysis was discontinued. Basin-wide analysis is now underway. Work plan and analytical models have been formulated. Additional data collection is underway.

SUPPORTED BY Nevada State Government - Carson City

2.0018. THE DETERMINATION OF THE FREQUENCY OF DROUGHT FLOWS OF VARYING DEGREES OF SEVERITY AND DURATION - NEW JERSEY

L.G. MILLER, U.S. Dept. of the Interior, Geological Survey, Trenton, New Jersey 08607

Information on the frequency of drought flows of varying degrees of severity and duration is needed for the proper analysis of water supply problems, administration of the New Jersey diversion law, studies of dilution of wastes, studies of effect of droughts on estuarine water quality, and studies of adequacy of quantity of water for cooling purposes and generation of power.

To evaluate and publish the frequency of drought flows of varying degrees of severity and duration at all gaging stations not seriously affected by regulation or diversion. To suggest how these low-flow frequencies might be used to estimate low flow figures at ungaged sites.

Gaging station data through the 1967 water year have been processed by a digital computer to obtain statistics of low flow. The severity of drought periods have been evaluated both in time and geographically. Data collected at partial-record stations have also been utilized in the analysis.

Determined 7-day low-flow discharges for 2-year recurrence intervals for about 15 low-flow partial-record stations for which relationships with nearby continuous-record gaging stations have recently been defined. Plotted these values on work map.

Prepare low-flow frequency data for publication.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

2.0019. EROSION AND DEPOSITION IN THE SANDS AND ESTUARIES OF THE NORTH CAROLINA COAST

RTED BY U.S. Dept. of Interior - Bu. Reclamation

HYGROSCOPIC SEEDING IN OKLAHOMA

ACCREADY, Flight Test Research Inc., Long Beach, California

In July 1971, because of apparent drought in west Oklahoma, a rainfall augmentation program was organized under the direction of the Division of Atmospheric Resources Management of the Bureau of Reclamation. Funding provided by the Federal Office of Emergency Readiness. The hygroscopic seeding project part of the program is discussed. Seeding flights were accomplished on 10 days during the period from mid-August to October, with a record wet September for Oklahoma. It is no way to make a valid evaluation of the success of the operational program. The program is described and some of the concepts and factors behind hygroscopic seeding are examined.

Pub. 71: 45p., NTIS No. PB-205 361; PC \$3.00 MF \$0.95. SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

FLORIDA CUMULUS SEEDING EXPERIMENT DROUGHT MITIGATION, APRIL-MAY 1971

ODDLEY, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302

As a result of the drought in south Florida in the fall of 1971, The Experimental Meteorology Laboratory undertook a dynamic cumulus seeding program in two target areas, one to the north and the other to the south of Okeechobee. In the 61-day operational period from April 31 May, flights were conducted on 16 days, with seeding on 14 days. Real time runs of the EML one-dimensional cumulus model on the 1200 GMT Miami mode eliminated 38 days as unseedable; seven additional seed days might have been obtained had a back-up aircraft been available. Altogether, 2066 50-gm AgI were dropped into 196 clouds or cloud complexes. After, seeded clouds produced about 180,000 acre-feet of rain. Conservative estimates ascribe about 100,000 acre-feet of rain, leading to a benefit-to-cost ratio for the program of about thirty-to-one.

Pub. 71: 166 p., NTIS No. COM-72-10149; PC \$3.00 MF \$0.95.

RTED BY U.S. Dept. of Commerce - N.O.A.A.

DROUGHT CLIMATOLOGY OF ILLINOIS

UFF, State Water Survey, Chicago, Illinois 60601

Analyses of the frequency distribution of droughts for periods of 3 to 60 months indicate that the relative severity is greatest in the southeastern, extreme southern and western regions of the state. Severe droughts having durations exceeding 24 months are infrequent in Illinois. In general, the regions of greatest drought severity are elongated

and elongated was terminated.

Pub. 1963: 74p., NTIS No. PB-220 413/9; PC \$5.75 MF \$0.95.

SUPPORTED BY Illinois State Government - Springfield

POTENTIAL OF PRECIPITATION MODIFICATION IN MODERATE TO SEVERE DROUGHTS

L. A. HUFF, State Water Survey, Urbana, Illinois 61801

Abstract: An investigation was made of the potential of precipitation modification in moderate to severe droughts in Illinois to alleviate water shortages in such critical periods. The study involved time and space analyses of the natural precipitation distribution and consisted of two phases. The first involved analyses of monthly precipitation characteristics in major 12-month and 24-month droughts in the 50-year period, 1906-55. The second phase was concerned with a detailed study of storm characteristics in the 1953-54 drought, one of the worst on record in Illinois. Results indicated that conditions occasionally prevail in some moderate to severe droughts during which successful cloud seeding might provide temporary relief over portions of an extensive drought region, especially with respect to providing agricultural relief. Potential for increasing municipal water supplies in the more severe drought conditions appear doubtful.

Pub. May 71: 42p., NTIS No. PB-228 817/3; PC \$4.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

DROUGHT IN KANSAS

M. J. BROWN, Kansas State University, Agricultural Experiment Sta., Manhattan, Kansas 66502

Abstract: The duration and intensity of meteorological droughts, as determined by the Palmer Drought Index (PDI), are reported for the nine crop districts of Kansas for 1931 through 1968. Results of the analysis can be used to determine dry and wet period expectancies, land use capabilities, and drought disaster areas. Summaries of overall moisture conditions are presented for each district for each month in the time period covered. Month to month variables and months of drought are indexed and tabulated. The beginning and ending dates, the maximum severity, and the number of months of drought are listed for each period. The percentage frequency of the various classes of drought (established by the PDI) are indicated for each climatological division. These climatological divisions correspond directly to the nine crop districts.

Pub. Mar. 71: 14p., NTIS No. COM-72-11021; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

BEACHES AND GROUND WATER OF CAPE SAN BLE, FLORIDA, DURING EXTREME DROUGHT

R. J. RUSSELL, Louisiana State Univ., Systems, Coastal Studies Institute, Baton Rouge, Louisiana 70803

Abstract: In October 1969 beaches and water tables were investigated after 5 months of adequate rainfall in the Cape

Sable complex. In April 1971 a similar study was made after 5 months of extreme drought in the Florida Everglades, when water tables were lowered and flattened enough to permit widespread saltwater intrusion. Much of the beach rock and cemented water-table rock under the beaches had been eroded by high-energy waves, probably of Hurricane Laurie (1969) or various local storms. Slabs of the eroded beach rock were tossed up on the beaches, and if sufficiently indurated became incorporated into the deposits. No evidence of subsequent cementation was observed. On East and Northwest capes the ground water had been replaced by stagnant seawater. On Middle Cape the water table was lowered, but a salinity gradient and some potable ground water were present in 1971. The Cape Sable region is isolated from mainland surface runoff by extensive areas of lakes and waterways with seawater salinities, and from subsurface flow of ground water by a thick section of compacted and compressed peat. Accumulation of ground water depends on local rainfall, and its volume varies with size and permeability of catchment areas. The conclusions of this study are applicable to many other coastal areas and may be useful in assessing their population and survival potentialities.

Pub. Aug. 71. 27p., NTIS No. AD-731 381; PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Defense - Navy

2.0015, SEVERITY AND FREQUENCY OF DROUGHT IN MISSISSIPPI

J.C. McPHORTER, Mississippi St. University, School of Agriculture, State College, Mississippi 39762

This project will develop a monthly water balance for six geographic and soil areas in Mississippi for the period 1943-1972. Moisture excesses and deficiencies will be determined, and then, the beginning and ending of drought periods will be observed. These periods will be classified according to degree of severity in order to secure the frequency of occurrence of a given drought.

Weather stations which are representative of each study area will be selected. Monthly temperature and precipitation values for each area will be determined from climatological records and values will be calculated for each area which represent the available water capacity in the root zone. Computer programs will be developed which use the above data to seek the severity and frequency of drought in Mississippi.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Reh.

2.0016, NEBRASKA DROUGHTS - A STUDY OF THEIR PAST CHRONOLOGICAL AND SPATIAL EXTENT WITH IMPLICATIONS FOR THE FUTURE

M.P. LAWSON, Univ. of Nebraska, School of Arts, Lincoln, Nebraska 68508

Abstract. The purpose of the report is to measure the spatial and temporal dimensions of drought occurrence in Nebraska. Such interpretations were facilitated by the computer generation of 468 maps showing monthly values of drought in Nebraska, from 1931 through 1969. While it was found that the frequency of consecutive drought is least in the central portion of the state, the intensity of drought is greatest in this region. Maps of correspondence which relate the areal correlation between rural population density and precipitation also indicate high positive relationships for central Nebraska. Interpretation of tree ring growth values using moving t-test plots did not demonstrate the cyclical recurrence of drought. A short review was conducted as to the economic and cli-

SUPPORTED BY U.S. Dept. of

2.0017, ECONOMIC EVALUATION OF WATER DEVELOPMENT OF WATER

H.C. LITTLE, Univ. of Nevada, Reno, Nevada 89507 (NEV002)

Objective: Provide a comprehensive analysis of the Central Lahontan Basin under existing conditions by relating economic and physical data so that planning may proceed on a more sound basis. Identification and description of the basin and its relation to limit the economic impact of future technological expansion of resources from agriculture to economic consequence of drought, evaluate changes in land and water more efficient use of resources to meet projected needs, and identify problems in the attainment of management, and development.

Approach: Identify present level of development, and economic projections and project needs for future development. Identify means of meeting future needs and development. Evaluate the alternative resource use and development techniques used include linear programming, amortization, and standard statistical analysis.

Progress: Subbasin analysis was completed and is now underway. Work plan has been formulated. Additional data are being collected.

SUPPORTED BY Nevada State

2.0018, THE DETERMINATION OF DROUGHT FLOWS OF SEVERITY AND DURATION

E.G. MILLER, U.S. Dept. of the Interior, Trenton, New Jersey 08607

Information on the frequency and degrees of severity and duration of droughts is needed for analysis of water supply problems. In New Jersey diversion law, studies of the effect of droughts on estimating adequacy of quantity of water for generation of power.

To evaluate and publish the frequency and degrees of severity and duration of droughts seriously affected by regulation of flow, these low-flow frequencies and flow figures at ungaged sites.

Gaging station data through the use of a digital computer to process the data to determine flow. The severity of drought both in time and geographical area. Record stations have also been identified.

Determined 7-dry low-flow discharge intervals for about 15 low-flow periods. Relationships with nearby conditions have recently been defined. A map.

Prepare low-flow frequency data

R.L. INGRAM, Univ. of North Carolina, School of Arts, Chapel Hill, North Carolina 27514

The objectives of this project are: (1) to determine the changes that are taking place in the bottom topography and shorelines of selected study areas typical of the total sound-estuary environment of the North Carolina coast, but especially Pamlico Sound; (2) to study the erosional and depositional processes responsible for these changes, and (3) to predict future changes.

How information will be applied: Information gained in this program will be used by State and Federal agencies to predict the effects on erosion and deposition of (1) storms; (2) changes in river regime from floods, droughts, dams; (3) soil conservation practices; (4) opening and closing of inlets; (5) dredging activities; (6) construction of shoreline facilities; (7) shoreline and bottom mining.

Accomplishments during the past twelve months: old and new aerial photographs of the study areas have been obtained and are being studied. Detailed bathymeter tracings are being made. The heavy mineral content of 173 samples has been used to estimate the source of the sands being deposited in the sounds and estuaries. The clay mineral content of 80 samples has been used to estimate the source of the clays being deposited in the sounds and estuaries. Box cores are being taken in the study areas.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

2.0020, DROUGHT AND WET SPELLS IN NORTH DAKOTA

J.M. RAHREIZ, North Dakota State University, Agricultural Experiment Sta., Fargo, North Dakota 58103 (ND04516)

Objective: Develop a model for determining the occurrence and probabilities of drought and wet spells in a subhumid climate. Apply the model to the soil survey and climatic data from several stations in the state.

Approach: An improved moisture accounting procedure to determine the occurrence, severity, and space distribution of drought and wet spells will be developed. An appropriate probability distribution function will be used to compute probabilities of occurrence, start and end dates, and severities of drought and wet spells using a dense climatological network in North Dakota. The basic model of W.C. Palmer for calculating the water balance will be considered and further refinements with respect to the number of soil layers with differing physical properties, depths of soil profile and winter moisture balance procedures will be made.

Progress: Fifty-five climatic stations from North Dakota have been selected for evaluation of drought and wet spell periods across the state. Moisture balance accounting models, based mainly on the Palmer Drought Index, have been developed to include the following modifications: weekly accounting of water balance; available soil water storage may be in varying numbers of soil layers according to soil type and varying characteristics of crops grown; variable water withdrawal factors are calculated to adjust the rate of water loss from each layer as affected by the water holding capacity of the layer and the amount of moisture present in it during the period in question; and accounting of winter precipitation in the cumulative moisture accounting procedure. The modified-moisture

Abstract: The authors review and suggest possible changes in Federal water resources policies and programs for reduction of losses from floods, drought, and hurricanes. Federal flood control policy is reviewed, leading up to the analysis of alternatives contained in the 1966 report of a task force on Federal flood control policy which is leading to changes in Federal policy. Response to the drought of the mid-1960's in Massachusetts is analyzed. Arguments are presented against single solutions, and emphasis is placed on the need for research on alternatives.

Pub. Dec. 71: 127p., NIS No. PH-211-922; PC \$5.15 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

2.0022, DEVELOPMENT OF RAINFALL DEFICIENCY INDEX FOR PUERTO RICO

J.E. CAPELL, Univ. of Puerto Rico, Agricultural Experiment Sta., Mayaguez, Puerto Rico 00928 (PR00169)

Objective: Characterize rainfall occurrence and recognize drought incidence in the agricultural regions of Puerto Rico by developing a suitable rainfall deficiency index.

Approach: The agricultural regions of Puerto Rico, defined on the basis of similar rainfall occurrence and temperature range, will be evaluated by their rainfall characteristics and agricultural drought incidence.

Progress: Two equations were developed to characterize rainfall distribution and rainfall deficiency, while involving different rainfall parameters to yield calculated yearly values which suggest the existence of cyclic trends over a 10- to 11-year span. On years ending in either 6 or 7, the drier part of the year becomes particularly dry while the rainfall distribution along these years is highly uneven relative to other years. Both conditions are reflected by the high values of the Rainfall Distribution Coefficient (RDC) and the correspondingly low values of the Rainfall Deficiency Index (RDI). Conversely, on years ending in either 1 or 2, the drier part of the year is least particularly dry while the rainfall distribution is generally then the most uniform. It may be observed that both circumstances occur about half-way between each other along the 10- to 11-year span. This situation is better defined for Caguas than for Fajardo. At the former location the RDC, which should approach 0.50 from above as an optimum value, shows mean values of 2.06 and 0.87 for the years of worse and better distributed rainfall, respectively. The RDI, which should approach 5.00 from below as an optimum value, shows mean values of -0.31 and 2.77 for the years of most and least deficient rainfall, respectively. In all cases the standard deviation of RDC and RDI is significantly lower when calculated for years ending in 6 or 7, or in 1 or 2, than when calculated for all the years. A manuscript on two proposed rainfall-characteristic indices was submitted for publication.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

2.0023, DROUGHT PROBABILITIES IN TENNESSEE

H.L. PARKS, Univ. of Tennessee, School of Agriculture, Knoxville, Tennessee 37916

Climatological data from selected stations that will give good representation of the State will be collected

2.0024. METEOROLOGICAL DROUGHT IN TENNESSEE

J.F. FAIKS/ORA, U.S. Dept. of Commerce, Natl. Weather Service, Nashville, Tennessee

Abstract: A 39-year climatology is presented to delineate occurrences of meteorological drought (abnormally dry weather) in various sections of the State. Occurrences of meteorological drought were obtained from a method developed previously (Palmer and Havers, 1958). Results are exhibited graphically for each of the four Climatological Divisions in the State. The data show: (1) the Eastern Division probably has a real seasonal difference in the frequency of serious drought, precipitation being less reliable in winter than in summer; (2) of the four divisions, serious drought (index less than -3.0) occurred least frequently in the Cumberland Plateau and most frequently in the Middle Division; (3) drought periods which lasted a year or more were most frequent in the Western Division and least frequent in the Eastern Division.

Pub. 1972: 9p., NTIS No. COM-73-10439; Reprint.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3. EARTHQUAKES

INDIVIDUAL ASSISTANCE

3.0001. EARTHQUAKES AND INSURANCE

UNKNOWN, Calif. Inst. of Technology, Center for Res. Prev. Disaster, Pasadena, California 91109

Abstract: The annual conference of the Earthquake Research Affiliates, was held in 1973 on the campus of the California Institute of Technology. Some of the papers presented at the conference dealt with earthquake hazards and insurance, and it was decided to publish them. Papers dealing with the 1906 San Francisco earthquake and the 1971 San Fernando earthquake which were discussed are also included.

Pub. Jul 73. 162p., NTIS NO. PB-223 033/2; PC \$10.25 MF \$1.45.

SUPPORTED BY California Inst of Technology - Pasadena

3.0002. STUDIES IN SEISMICITY AND EARTHQUAKE DAMAGE STATISTICS, APPENDIX A

K.P. STEINBRUGGE, U.S. Dept. of Commerce, Natl. Ocean Survey, Rockville, Maryland 20852

Abstract: The report discusses engineering, insurance and the influence of deductibles on the amount of loss with respect to earthquake damage to wood frame dwellings.

Pub. 1969: 148p., NTIS No. COM-71-00053; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

PUBLIC ASSISTANCE

3.0003. LITERATURE SURVEY SEISMIC EFFECTS ON HIGHWAY BRIDGES

T. IWASAKI, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

capacity and stability of soils, earth pressures, hydraulic pressures, dynamic properties of bridges, field measurements of earthquake response of bridges, dynamic analyses of bridges, and laboratory experiments. Specifications for the earthquake-resistant design of bridges as used by many organizations are also included.

Pub. Nov. 72: 434p., NTIS No. PB-215 613/1; PC \$6.00 MF 0.95.

SUPPORTED BY University of California

3.0004. REPORTS OF THE EARTHQUAKE TASK FORCES - RECOMMENDATIONS OF THE LOS ANGELES COUNTY EARTHQUAKE COMMISSION

UNKNOWN, Los Angeles Co. Bd. of Supvrs., Los Angeles, California

This briefly highlights the work of the six Earthquake Task Forces appointed by the Board of Supervisors and presents recommendations concerning the problems identified by the Los Angeles County Earthquake Commission in its report of November 1971. The recommendations are set forth on a subject by subject basis and also on an agency by agency basis. These two arrangements identify what is totally recommended on each topic and what is totally recommended to each concerned jurisdiction or agency.

The subjects are: hazardous old buildings, safety of dams, highway structures, code revisions, facilities vital in emergencies, federal construction, schools, houses, earthquake insurance, non-structural damage, utilities, instrumentation of major structures research, strong ground shaking and faulting, and emergency operations for earthquakes.

Pub. Mar. 72: 61p., no copy info available.

Abstract provided by FEMA.

SUPPORTED BY Los Angeles County Government - California

3.0005. BEHAVIOR OF UNDERGROUND BOX CONDUITS IN THE SAN FERNANDO EARTHQUAKE OF 9 FEBRUARY 1971

P.J. HRADILEK, U.S. Army, Engineer District, Los Angeles, California 90053

Abstract: A study of the behavior of two flood control channels in the San Fernando earthquake of 9 February 1971 is presented. The report concentrates on the underground conduit reaches of these channels. A detailed account of the heavily damaged areas is presented. Correlations are made between tectonic movements and the behavior of the conduits. One conduit was crossed by a segment of the main fault break. Points on either side of the break experienced vertical, transverse and longitudinal offsets of about 4, 6 5, and 4 feet, respectively. Extensive areas of the conduits suffered failure of the walls due to lateral loads. Evidence of plastic hinge formation was encountered.

Pub. Jan. 72: 171p., NTIS No. AD-739 605; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

3.0006. VAN NORMAN RESERVOIRS AREA, CALIFORNIA

San Fernando earthquake (M 6 1/2). The investigation and reports are complete: the permanent ground deformations associated with the 1971 earthquake were mapped in detail and found to extend into the reservoir area and to reproduce or renew long-established features related to the active regional tectonic system; the distribution, attitude, history, and activity of faults in the reservoir area were determined and their relation to the regional fault system established; these local and regional relations, plus the tectonic setting and seismic history of the region, indicate that a magnitude 7.7 earthquake should be expected in the Van Norman area. The transitory and permanent effects of such an earthquake were derived.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0007, PRELIMINARY INVESTIGATION OF STRUCTURAL DAMAGE FROM POINT MUGU, CALIFORNIA EARTHQUAKE OF FEBRUARY 21, 1973

S.K. TAKAHASHI, U.S. Navy, Civil Engineering Lab., Port Hueneme, California 93041

Abstract: The report contains information and photographs obtained during a preliminary investigation of structural damage caused by the Point Mugu, California earthquake of 21 February 1973. The earthquake was rated at 5.9 on the Richter scale and caused widely scattered minor damage to residential buildings, damage to numerous stores with perishable and fragile goods, and resulted in unsafe conditions in many older unreinforced structures. Structural damage also occurred at the U.S. Naval Missile Center at Point Mugu. Damage to a three-story barracks, to a two-story Headquarters building, to an airfield hangar and to other facilities are described.

Pub. Aug. 73: 37p., NTIS No. AD-768 293/3: PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0008, COST-BENEFIT RISK ANALYSIS OF RESEARCH BUDGETING FOR EARTHQUAKE HAZARD MITIGATION

J.H. WIGGINS, John H. Wiggins Company, Redondo Beach, California 90277

The project will investigate the possible effects of earthquake engineering research expenditures on life and property loss from future U.S. earthquakes. Four specific times in the next thirty years will be examined and the effects of possible earthquake activity obtained. The three specific 'events' to be examined are: a recurrence of the 1811-1812 New Madrid earthquake, a recurrence of the 1906 San Francisco earthquake, and the total expected annual U.S. earthquake occurrences. Each possible event will be investigated for each possible state assuming different availability of research results. The potential damage mitigation will be accomplished by: 1) estimating the expected damages to the U.S. during each event; 2) estimating the costs of reducing those damages as a function of research dollars available and the types of research at which these dollars are directed; and 3) estimating the damageability reduction attributable to

This report describes an innovative study which for the first time examines the national earthquake loss problem and develops a justifiable earthquake engineering research budget aimed at loss mitigation. The approach taken was to sweep the known earthquake occurrence history (hazard) over the exposed construction for the entire 50 United States and calculate annual damages, deaths and injuries in constant 1970\$ for the years 1970, 1980, 1990 and 2000. Also examined were two scenarios, the recurrence of the San Francisco 1906 and New Madrid 1811-1812 earthquakes during the same years, 1970, 1980, 1990 and 2000. These gave a perspective on extreme, sudden loss estimates of damage as well as annual loss estimates and the effect of potential mitigation adjustments.

A number of operations and estimations were used throughout the study, each of which were independent variables affecting the outcome of the report. The framework and operational procedures developed is an important outcome. Many other hazards other than earthquake can be treated in a like manner in order to learn about budgeting for research in the other areas.

There are many tables of results that can be used by interested readers to examine specific questions in more detail.

Pub. May 74: 130p., Tech. Report No. 74-1201-1; J.H. Wiggins Co., 1650 So. Pacific Coast Highway Redondo Beach, Calif. 90274.

Abstract provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

3.0010, EARTHQUAKE-INDUCED EMBANKMENT DISTRESS

R.A. FORSYTH, State Div. of Highways, Sacramento, California 95814 (2R63220117)

The objectives are to survey and catalog the earthwork damage, determine the mechanisms involved in causing the damage, and to make recommendations for minimizing earthquake damage on future projects. Ground breakage will be mapped, earthwork damage will be related to geologic features, design, and construction methods.

Document provided to S.S.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - FHWA.

3.0011, URBAN GEOLOGY - PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, AND COSTS OF GEOLOGIC HAZARDS AND RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

UNKNOWN, State Div. of Mines & Geology, Sacramento, California 95814

The results of a three-year study of geologic problems in California are presented. The total projected loss attributable to property damage, life loss and loss of mineral resources, including both direct and indirect costs, caused by ten geologic problems in California from 1970 to 2000 is estimated to be \$55 billion. Four problems- earthquake shaking, loss of mineral resources, landsliding, and flooding- account for 98 percent of the total projected loss. The remaining 2 percent of the estimated loss is due to erosion, activity, and

tures is estimated at \$6 billion, for an overall benefit: cost ratio of 6.2:1. In addition, then, to satisfying the needs for increased public safety and the social and political concerns therefor, geologic hazards loss-reduction is also "good business."

The degree of effectiveness of the various types of loss-reduction measures possible are reviewed and recommendations are presented. The most effective action that can be taken is for cities and counties to strengthen and diligently enforce existing grading ordinances and building codes.

A methodology for setting priorities for the application of loss-reduction measures is presented. The study concludes that no single ranking of priorities with respect to localities, specific problems, or particular loss-reduction programs, is feasible; but the actions taken should commence in the more populated and the more hazardous areas.

Pub. 73, 112p., No copy info available

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

3.0012, THE SAN FERNANDO EARTHQUAKE SOILS AND GEOLOGIC INVESTIGATIONS IN RELATION TO HIGHWAY DAMAGE

R.H. PRYSOCK, State Materials & Res. Dept., Sacramento, California

Abstract: The overall objective of the study is to develop recommendations concerning design and construction for minimizing distress of highway earthworks during future earthquakes. This report describes the effects of the San Fernando earthquake on freeway earthworks. Generally cut slope performance was good although three slides did occur in very large cuts. Two developed in the upper portions of the slopes and did not collapse completely. Embankments were susceptible to shear failure, subsidence caused by densification, spreading, and longitudinal and transverse cracks. Damage to fills caused by shear failure was considered minor although three slip-outs did develop in very good material. Widespread settlement at bridge approaches occurred on all freeways surveyed for damage.

Pub. Sep. 71, 57p., NTIS No. PB-204 369; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Transportation - FHWA.

3.0013, INVESTIGATION OF GROUND MOTION-DAMAGE RELATIONSHIPS FOR RESIDENTIAL BUILDINGS IN GLENDALE, CALIFORNIA- SAN FERNANDO EARTHQUAKE, FEBRUARY 1

I. FARHOMAND, John A. Blume & Associates, San Francisco, California

The investigation of the relationship between the observed damage to the residential buildings in two selected control areas within Glendale, California, and the ground motion resulting from the San Fernando earthquake is presented. The procedures used in performing the structure inventory and the damage survey are described. The ground motion characterization, structure idealization, and damage description used to derive the ground motion damage relationships are also given. Results of the investigation are ground motion-damage relationships for overall building damage as well as for building components. One of the more significant conclusions is that interior walls and chimneys are more susceptible to damage than other building components.

3.0014, RESPONSE OF TWO IDENTICAL, SEVEN-STORY STRUCTURES TO THE SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971

S.A. FREEMAN, John A. Blume & Associates, San Francisco, California

The results of the structural dynamic investigation of two seven-story reinforced concrete frame structures are presented here. The structures are both Holiday Inn motor hotels that are essentially identical: one is located about 13 miles and the other about 26 miles from the epicenter of the February 9, 1971, San Fernando earthquake. Appreciable nonstructural damage as well as some structural damage was observed. Strong-motion seismic records were obtained for the roof, intermediate story, and ground floor of each structure. The analyses are based on data from the structural drawings, architectural drawings, photographs, engineering reports, and seismogram records obtained before, during, and after the San Fernando earthquake. Both structures experienced motion well beyond the limits of the building code design criteria. A change in fundamental period was observed for each structure after several seconds of response to the earthquake, which indicated nonlinear response. The analyses indicated that the elastic capacity of some structural members was exceeded. Idealized linear models were constructed to approximate response at various time segments. A method for approximating the nonlinear response of each structure is presented. The effects of nonstructural elements, yielding beams, and column capacities are illustrated. Comparisons of the two buildings are made for ductility factors, dynamic response characteristics, and damage. Conclusions are drawn concerning the effects of the earthquake on the structures and the future capacities of the structures.

Pub. Oct. 73, 70p., NTIS No. JAB-90-98; PC \$5.45 MF \$1.45

SUPPORTED BY U.S. Atomic Energy Commission

3.0015, OBSERVATIONS OF DAMAGE TO GLENDALE SWIMMING POOLS, MOBILE HOMES, AND COMMERCIAL BUILDINGS RESULTING FROM SAN FERNANDO EARTHQUAKE OF 1971

W.H. NELSON, John A. Blume & Associates, San Francisco, California

No summary has been provided to the Smithsonian Science Information Exchange.

Pub. Oct. 72, 57p., NTIS No. JAB-90-91; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Atomic Energy Commission

3.0016, SEISMIC MOTION-DAMAGE RELATIONSHIPS FOR LOW RISE BUILDINGS - COLORADO

R.E. SCHOLL, John A. Blume & Associates, San Francisco, California

The Rio Blanco event, a nuclear gas stimulation experiment in Northwestern Colorado, provides a unique opportunity to examine the response of low rise buildings to strong motion excitation and to correlate these changes with seismic ground motion histories. The measurement program involves determining the response of twelve low rise structures of varying construction quality and techniques located at varying distances from an underground nuclear detonation. The recorded data will be digitized and a preliminary analysis will be performed to determine the quality of the data.

SUPPORTED BY U.S. Natl. Science Foundation

3.0017, DAMAGE SURVEY, SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971

The results of an earthquake damage field survey conducted after the Feb. 9, 1971 San Fernando earthquake are summarized. The survey was performed to collect data regarding earthquake damage or lack of damage to structures, systems, and equipment relating to nuclear power plant components whose function is safety related. The survey covered dams, embankments, and channels; communication systems; electrical substations, switching and transmission facilities; mechanical and electrical equipment including generators, piping systems, and emergency power generating systems; piping systems; structures including highway overpasses, power houses, tanks, and stacks; and underground utilities and tanks. Recommendations for future analytical studies are presented.

Pub. Mar. 71: 87p., NTIS No. JAB-DRS-1: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Atomic Energy Commission

3.0018, STRUCTURAL EFFECTS OF THE FAIRBANKS, ALASKA EARTHQUAKE OF JUNE 21, 1967

UNKNOWN, John A. Blume & Associates, San Francisco, California

An earthquake with three primary shocks of Richter magnitudes 5.4, 5.6, and 5.4 (U.S. Coast and Geodetic Survey) occurred 15 kilometers east southeast of Fairbanks, Alaska, on June 21, 1967. The earthquake caused slight to moderate damage to structures in Fairbanks and at nearby Ft. Wainwright. Ground motion was felt over an area of 90,000 square miles, extending as far as Anchorage, 415 kilometers to the southwest. The Fairbanks earthquake was assigned a maximum Modified Mercalli intensity of VII by the U.S. Coast and Geodetic Survey. The three primary shocks evidently had the same epicenter location, 64.8 degrees N, 147.7 degrees W. Aftershocks, which continued for several days, had a common epicenter which was located close to the epicenter of the three major shocks. Damage reported consisted essentially of cracked and displaced walls, broken panes of glass, and fallen ceiling tiles and panels. No street damage was reported, although there was one case of earth subsidence at Ft. Wainwright.

Pub. Mar. 70: 39p., NTIS No. JAB-99-51: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Atomic Energy Commission

3.0019, ENGINEERING SEISMOLOGY

L.R. ALDREDGE, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302 (22390523)

Technical objective: To investigate the effects of strong earthquake ground motions on man-made structures and to correlate those results with studies of ground breakage--both primary faulting and secondary breakage--in an effort to minimize the loss of life and property in future large earthquakes.

Approach: Conduct prompt, on-the-spot field investigations of the effects of strong earthquakes as seen from a seismo-tectonic viewpoint; develop improved techniques to identify primary fault breakage and secondary surficial effects of similar appearance, and to correctly differentiate one from the other; interpret detailed damage patterns from strong and destructive earthquakes in terms of ground breakage effects; continue efforts to expand the overall dynamic recording

celerations seen at several places lends further credibility to the unusually high accelerations recorded at Pacoima Dam.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3.0020, SEISMIC RISK - FDAA - WASHINGTON AND UTAH

S.T. ALGERMISSIN, U.S. Dept. of the Interior, Geological Survey, Boulder, Colorado 80302

Prepare intensity maps for the postulated damaging earthquakes. Prepare a report on the potential damage, probable casualties, and evaluation of debris clearance for use by disaster relief agencies.

Maps indicating the estimated distribution of Modified Mercalli intensity in the Puget Sound area in the event of the occurrence of magnitude 7 earthquakes (1) near the hypocenter of the 7.1 shock of 1949, and, (2) near the hypocenter of the magnitude 6.5 shock of 1965, are nearly completed.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0021, PERFORMANCE OF SINGLE FAMILY DWELLINGS IN THE SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971

F.E. MCCLURE, U.S. Dept. of Hou. & Urb. Dev., Off. of Policy Dev. & Res., Washington, District of Columbia 20410

Abstract: The report presents the results of an in-depth engineering study of 169 single family dwellings damaged in the 1971 San Fernando earthquake selected in such a manner as to provide data for evaluation of present HUD accepted methods of single family structure location, site planning, engineering, structural design and construction. In addition to the analysis of the damage dwelling survey data, the conclusion and recommendations in this report are based on inspection of damaged dwellings immediately following the earthquake, review of dwelling damage reports prepared by others and interviews with building officials, contractors and dwelling owners.

Pub. May 73: 148p., NTIS No. PB-226 293/9: PC \$9.50 MF \$1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

3.0022, REPORT INTO SELECTED AREAS OF ECONOMIC IMPACT OF THE CALIFORNIA EARTHQUAKE FOR THE OFFICE OF EMERGENCY PREPAREDNESS (ABBREV)

J.V. COYNE, Public Administration Service, Chicago, Illinois 60637

This current inquiry has been directed primarily to the experience of the California earthquake of February 9, 1971, as it sheds light on three types of economic impact which have been the subject of complaint or representations: the middle-income citizen whose disaster losses are heavy, the damaged private, nonprofit community hospital, and the private contractor who has public facilities under construction when they suffer disaster damage.

Suggestions for dealing with these situations have been made against a backdrop of what has been judged to be the currently accepted role, policy, and purpose of the Federal Government in disaster relief.

A.J. SCHIFF, Purdue University, School of Aeronautics,
Lafayette, Indiana 47907

The San Fernando Valley Earthquake (SFVE) of February 9, 1971, subjected many works of man in the affected areas to a severe test of their resistance to earthquake damage. It served as a poignant reminder that existing specifications for earthquake design and construction procedures are inadequate. Observation and analysis of the various failures has provided an opportunity to evaluate and improve upon existing procedures.

This report is concerned with the impact of earthquakes on electric power systems, with particular attention focused on the following three areas: (a) The effects of an earthquake on the power network in the Western States. (b) The failure of subsystems and components of the power system. (c) The loss of power to hospitals.

Pub. Jan. 72; 76p., Report 72-1.

Abstract provided by FDA.

SUPPORTED BY U.S. Natl. Science Foundation

3.0024, STUDIES IN SEISMICITY AND EARTHQUAKE-
DAMAGE STATISTICS, APPENDIX B

S.T. ALGERMISSEN, U.S. Dept. of Commerce, Natl. Ocean Survey, Rockville, Maryland 20852

Abstract: The report presents a methodology for the computation of losses to residential dwellings in California resulting from earthquakes.

Pub. 1969: 70p., NTIS No. COM-71-00015-1; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A. A.

3.0025, THE SANTA ROSA, CALIFORNIA,
EARTHQUAKES OF OCTOBER 1, 1969

K.V. STEINBRUGG, U.S. Dept. of Commerce, Natl. Ocean Survey, Rockville, Maryland 20852

Abstract. Santa Rosa, Calif., was damaged at 11:57 p.m. (Pacific daylight time) on Oct. 1, 1969, by a magnitude 5.6 earthquake located very close to the city. Later the same evening at 11:20 p.m. a second earthquake also centered near the city and having a 5.7 magnitude, created additional damage. Since repairs obviously could not be made between earthquakes, since the damage was cumulative, the two events should be considered as a single series of earthquakes from a damage standpoint. The Santa Rosa earthquakes of Oct. 1 are of substantial engineering interest because of disproportionate damage to earthquake-resistant buildings and because of the concentration of dwelling damage into a relatively small area, among other reasons. The recent marked increase in public interest in earthquakes has also focused attention on the damage in Santa Rosa. Thus, the engineering and scientific findings, as well as the recommendations developing from these earthquakes, may well have a greater-than-usual impact on public policy. This report is essentially directed toward the engineering aspects of the earthquakes.

Pub. 1970: 113p., NTIS No. COM-71-00130; MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

00026, DAMAGE STATISTICS FOR HIGH-RISE BUILDINGS IN THE VICINITY OF THE SAN FERNANDO EARTHQUAKE

matrices, showing the relationships distance, intensity of ground shaking and given separately for steel and concrete to the various structural and nonstructural elements described separately. The difficult problem is explained, and suggestions are given for future earthquakes.

Pub. April 74, 1999, Optimum Systems
Damage Statistics Report No. 1, Dep.
Mass. Inst. of Technology, Cambridge.

Abstract provided by FDA

SUPPORTED BY U.S. Natl. Science F.

ABSTRACT: LOW CYCLE FATIGUE FAILURE STRUCTURES

L. KASTRAJ, Univ. of New Mexico, 1
Research, Albuquerque, New Mexico 8

Abstract Low-cycle fatigue damage for a single degree of freedom system subjected to the El Centro (1941 and 1940), OH (1952) earthquakes. Maximum displacement, fatigue failure criteria are also considered, and maximum strain rate for a simple frame with rectangular column in reversals of loadings. The load and strain curves are proposed to give the structures having average wide flange hysteresis loops are utilized for finding maximum structure strain variation. Finally the corresponding cumulative damage is then obtained.

Pub. Sep 68; 86p., NIS No. PH 198-37
 SUPPLEMENTARY U.S. Nat. Security

DISASTER MEDICA

ABSTRACT

U.C. BERKELEY, Univ. of California, School
California 94720

The aim of this work is to evaluate the scientific and engineering questions at the ground during substantial earthquakes, be concerned with parameters of an optimal estimation of intensity of shaking ground velocity, and such as the duration a function of frequency and proper seismological considerations are involved understanding of rupture dynamics, of the effect of geological structure. Detailed studies will be pursued in intensity and the historical record in attenuation and duration of strong ground motion from available records and the influence of fault type on the partitioned and horizontal ground motion, use element models for complex structure response to test various claims on

P. CHAKRABARTI, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Influence of hydrodynamic interaction on the dynamic behavior of dams is reduced to two dimensions; the material behavior is assumed to be linearly elastic. For analysis in the frequency domain, the system is considered as two substructures: (1) the dam as a finite element system and (2) the reservoir's fluid as a continuum of infinite length upstream governed by the wave equation. The displacements of the dam including hydrodynamic effects are expressed in linear combination of the modes of vibration of the dam with the reservoir empty. The analysis produces exact results if all modes of vibration are included; however it effectively produces excellent results by considering only the first few modes, thus drastically reducing the number of unknowns. Numerical results for complex frequency responses and responses to earthquake ground motions show: (1) hydrodynamic interaction and compressibility of water must be considered to obtain accurate results for the periods of vibration and response to earthquakes, (2) water in the reservoir significantly increases the lateral displacements from earthquake motion; however, the stresses may not increase, depending on the ground motion frequency characteristics, and (3) compared to many classes of structures, the vertical component of ground motion is more important in the response of gravity dams.

Pub. Dec. 72: 172p., NTIS No. AD-762 330: PC \$6.00 MF \$0.95.

SUPPORTED BY University of California

3.0030, EARTHQUAKE ANALYSIS OF MULTISTORY BUILDINGS INCLUDING FOUNDATION INTERACTION

A.K. CHOPRA, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Efficient methods for dynamic analysis of response of multistory buildings including foundation interaction to earthquake ground motion are presented. The system considered is a shear building on a rigid circular disk footing attached to the surface of a linearly elastic half-space. In the first method, structural displacements are transformed to normal modes of vibration of the building on a rigid foundation. The analysis procedure is developed and numerical results are presented to demonstrate that excellent results can be obtained by considering only the first few modes of vibration. The second method developed is based on the Ritz concept. The structural displacements including those at the base are expressed as a linear combination of Ritz Vectors, which are selected as the first few modes of an associated building-foundation system. Numerical results are presented to demonstrate the effectiveness of this approach.

Pub. Jun. 73: 49p., NTIS No. PB-222 970/6: PC \$3.00 MF \$1.45.

SUPPORTED BY University of California

3.0031, EARTHQUAKE RESPONSE OF CONCRETE GRAVITY DAMS

A.K. CHOPRA, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Including reservoir interaction effects, the response of

in the fundamental mode. Four cases were considered: dam alone (without reservoir), reservoir-dam system -- interaction neglected, reservoir-dam system -- interaction included, and reservoir-dam system -- interaction included but water compressibility neglected. Expressions were derived for the complex frequency response functions for the dam displacement and lateral hydrodynamic force in each of these four cases. These results along with the Fast Fourier Transform algorithm were utilized to compute the time-history of responses of 28 reservoir-dam systems to the Taft earthquake.

Pub. Jan. 70: 40p., NTIS No. AD-709 640: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Army

3.0032, ENERGY ABSORPTION CHARACTERISTICS OF STRUCTURAL SYSTEMS SUBJECTED TO EARTHQUAKE EXCITATION

R.P. CLOUGH, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

This is a continuation and expansion of work initiated under previous NSF grants. The program of activities includes testing of structural components such as reinforced concrete beams and beam-columns, reinforced concrete beam and column subassemblies and reinforced concrete frames with spandrel walls. The moderate size earthquake simulator will be used to verify, extend and modify analytic understanding of the earthquake response of steel rigid and braced frames, reinforced concrete bare frames, reinforced concrete frames with shear or infilled walls and masonry structures. The results of these experimental activities will be correlated with theory and compared with results of a separate field test program. Concurrent analytic research will be directed toward developing computational procedures with which engineers can predict the inelastic response of real structures under strong earthquakes, the amount of damage likely to be inflicted, and the possibility of complete collapse, with sufficient accuracy and economy for practical purposes.

SUPPORTED BY U.S. Natl. Science Foundation

3.0033, STOCHASTIC INELASTIC RESPONSE OF OFFSHORE TOWERS TO STRONG MOTION EARTHQUAKES

M.K. KAIL, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Complexities of stochastic analysis of offshore towers include nonlinear effects due to coupling of the hydrodynamic drag forces with structural response, non-linear effects due to hysteretic force deformation relations to the tower, and non-stationary random excitation and response. They are overcome by introducing certain approximations not affecting the numerical results seriously. Semi-closed form solutions are derived for the time dependent variances of response. Passing shot noise through a second order linear filter simulates ground acceleration. Internal tower forces are generated using linear and bilinear hysteretic relations, resulting in a full stiffness matrix where the tri-diagonal terms are time dependent to account for hysteretic effects. Finally equivalent linearizations lead to a system of first order non-linear differential equations with the time dependent variances of response as the unknowns, which are determined by

3.0035,

C. LAAP, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: A general method for linear analysis of response of axisymmetric towers, partly submerged in water, to earthquake ground motion is presented. Based on results of the first part of this investigation in which the basic mechanism of structure-water interaction is studied, water is treated as incompressible in the analysis. The effects of surrounding water on the earthquake response of towers are studied. It is demonstrated that these effects are generally significant.

Pub. Oct. 73; 176p., NTIS No. AD-773 052/6; PC \$5.50 MF \$1.45.

SUPPORTED BY: U.S. Dept. of Defense - Army

3.0035, SHAKE - A COMPUTER PROGRAM FOR EARTHQUAKE RESPONSE ANALYSIS OF HORIZONTALY LAYERED SOILS

P.B. SCHNABEL, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: The program computes the response in a horizontally layered soil-rock system subjected to transient, vertical travelling shear waves. The method is based on Kana's solution to the wave equation and the Fast Fourier Transform algorithm. The motion used as basis for the analysis can be applied to any layer in the system. Systems with elastic base and with variable damping in each layer can be analyzed. Equivalent linear soil properties are used with an iterative procedure to obtain soil properties compatible with the strains developed in each layer. A varied set of operations of interest in earthquake response analysis can be performed.

Pub. Dec. 72; 105p., NTIS No. PB-220 207/5; PC \$3.00 MF \$0.95.

SUPPORTED BY: University of California

3.0036, EARTHQUAKE ANALYSIS OF STRUCTURE-FOUNDATION SYSTEMS

A.K. PAISH, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: A computationally efficient procedure for the linear earthquake analysis of structure-foundation systems is developed, which is specially suited to finite element solutions of complex shaped structures on large, layered foundations. The procedure is very general in scope, being applicable to a large variety of structure-foundation interaction problems. An explicit formulation of the procedure is presented for a plane strain idealization of a dam foundation system. The procedure utilizes a substructure approach. The foundation is analyzed first, independently of the structure, to obtain its frequency dependent compliance characteristics at the connection nodes with the structure. Equations of motion for the structure are then written in the frequency domain incorporating the effect of the foundation, the input to the problem being the freefield motion of the structural base. The substructure approach allows a more detailed modelling of the structure.

Pub. May 73; 141p., NTIS No. AD-766 272/9; PC \$3.50 MF \$1.45.

SUPPORTED BY: U.S. Dept. of Defense - Army

earth under static loading conditions, the possible effect of an earthquake, available by which even approximate limits are therefore required to extend limited earth into the area of concern. It is to develop a method which the stability of reinforced earth structure loading conditions. The studies will Analytical, including both prototype studies, using a finite element method, on scale structure built on a shaking table, two prototype retaining walls, and one type of seismic loading. A time analysis will be used incorporating non-linearities for the soil and reinforcing construction techniques. The results studies will be checked against a specimen from shaking table tests using. One or more large prototype retaining walls built at the UCLA field station, both static and artificially induced, reinforced and composed with the developed analytical method. Will mainly with reinforced earth retaining that the results will have wide application to soil and soil structure problems under loading conditions. There would include possible use of reinforcing in conditions.

SUPPORTED BY: U.S. Soil Science Experiment Station, IMPACT VIBRATION, DAM DESIGN

VI. MEHRI, Univ. of Southern California, Los Angeles, California 90089

The program will entail a comprehensive, mental study to investigate the response of a system subjected to multiple impact excitation with the following objectives: the non-stationary random response of a response of system equipped with multiple impact dampers, to determine the effectiveness of operating conditions and multiple impact dampers, to investigate the behavior of multiple dampers, to determine the optimum combination of various operating conditions. The response characteristics of multiple dampers provided with impact dampers and graphical form suitable for design applications of multiple dampers of free and impact dampers, to non-circular and irregularly recorded earthquakes, with the results to be published in a series of multiple studies.

SUPPORTED BY: U.S. Soil Science Experiment Station

3.0039, REINFORCED CONCRETE DAMS ANDREAS LAPEL, CALIFORNIA

LAPEL, DIBBET, U.S. Dept. of the Interior

piled onto four specially prepared 1:125,000-scale topographic base maps, each covering a 125-km long segment of the San Andreas fault. Each of these geologic maps will be accompanied by several cross sections and descriptions of the rock units. Also planned for publication are several 1:62,500-scale quadrangle transects astride certain critical parts of the fault.

The basic geology mapped throughout this area will serve many purposes, such as location of materials suitable for construction of highways, canals, and dams, location of geologic hazards such as faults, landslides, and unstable rock units, and classification of land and exploration for water, petroleum or gas and mineral deposits.

SUPPORTED BY U.S. Dept of Interior - Geological Survey

3.0040. MEASUREMENTS OF DYNAMIC CHARACTERISTICS OF MULTISTORY BUILDINGS IN CALIFORNIA

H.C. SHAH, Stanford University, School of Engineering, Palo Alto, California 94305

During the first year of study dynamic measurements were made on buildings in San Francisco, Palo Alto and Los Angeles, and on a suspension bridge in Sacramento. Measurements of structures will be continued under ambient conditions to determine (1) the effect of occupancy on the dynamic characteristics, (2) the variation in dynamic characteristics for similar buildings, (3) the relationships between the frequencies and modal damping values at ambient force levels to those for strong motions, and (4) the relationships between analytical predictions and results obtained from ambient measurements. The dynamic characteristics to be studied include accelerations, displacements, natural frequencies, spectra, transfer functions, etc.

SUPPORTED BY U.S. Natl. Science Foundation

3.0041. EARTHQUAKE RESPONSE OF BUILDING-FOUNDATION SYSTEMS

J. BHALLAK, Calif. Inst. of Technology, Earthquake Engin. Res. Lab., Pasadena, California 91109

Abstract: The investigation on the dynamics of soil-structure interaction was divided into two parts for convenience of analysis and presentation. In Chapter I, the fixed horizontal, rocking and vertical harmonic oscillations of a rigid disc perfectly bonded to an elastic half-space were studied. The effect of a deformable foundation on the response of a building to earthquake excitation was studied in Chapter II. The base of the building was idealized as a rigid circular plate attached to the surface of the ground, and the soil was modeled by a homogeneous, isotropic, elastic half-space. Using the force-deflection relations for the base derived in Chapter I, the equations of motion of an *n*-story building-foundation system were solved by both direct and transform methods. For special case of a single-story building on a flexible foundation, approximate explicit formulas were obtained for the effective natural frequency, critical damping ratio, and the amplitude of the modified excitation in terms of the dimensionless parameters which govern the behavior of the system.

Pub. 1971-1535. NTIS No. PB-209 666. PC \$3.00 MF \$0.95

During the completion of the grant GK-28182, an unprecedented amount of strong motion data has been collected from the San Fernando Earthquake and several of its larger after shocks. This data has been collected and digitized; however, it has not been analyzed and published. This grant will complete the analysis of the majority of the San Fernando records and publish them with the appropriate analysis. The analysis of the records will include the integration of the acceleration to obtain velocity and displacement histories.

Damped spectra will be obtained for both the velocity and acceleration functions. These calculations are an integral part of the analysis of the earthquake's effect on structures. Their timely completion and dissemination will prove invaluable to the research and professional engineers. In addition to the San Fernando records, several records obtained from previous earthquakes by the same instrument net will be processed. These records will be useful in comparative studies of the effects of different source and site mechanisms on the response of structures.

SUPPORTED BY U.S. Natl. Science Foundation

3.0043. DYNAMICS OF BUILDING-SOIL INTERACTION

P.C. JENNINGS, Calif. Inst. of Technology, Earthquake Engin. Res. Lab., Pasadena, California 91109

Abstract: In this study of the dynamics of building-soil interaction, the soil is modeled by a linear elastic half-space, and the building structure by an *n*-degree-of-freedom oscillator. Both earthquake response and steady-state response to sinusoidal excitation are examined. The results show that interaction tends to decrease all resonant frequencies, but that the effects are often significant only for the fundamental mode for many *n*-story structures and are more pronounced for rocking than for translation. If the fixed-base structure has damping, the effects of interaction on the earthquake responses are not always conservative, and an increase or decrease in the response can occur, depending on the parameters of the system.

Pub. Apr. 72: 81p., NTIS No. PB-209 666. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

3.0044. GENERAL REVIEW OF THE SEISMIC HAZARD TO SELECTED U.S. NAVY INSTALLATIONS

J.B. SEED, Calif. Inst. of Technology, Graduate School, Pasadena, California 91109

Abstract: The report summarizes the findings of the Natural Hazards Review Panel whose mission it was to investigate the nature and magnitude of the threats posed to Naval bases by earthquakes and earthquake-related natural hazards including tsunamis, seiches (and the accompanying flooding), landslides, mudflows and soil foundation failures which may result from earthquakes. In addition to citing specific problems for Naval bases in the San Francisco, San Diego and the Manila areas, the introduction to this report recommends conducting a rapid visual survey initially to pinpoint the nature of various danger areas. It then recommends the follow-on procedure leading to various strategic and en-

3.0045, DYNAMIC ANALYSIS OF COUPLED SHEAR WALLS AND SANDWICH BEAMS

K.S. SKATTUM, Calif Inst of Technology, Earthquake Engin. Res. Lab., Pasadena, California 91109

Abstract: A study is made of the free vibration of planar coupled shear walls, a common lateral load-resisting configuration in building construction where two walls are coupled together by a system of discrete spandrel beams. The differential equations and boundary conditions are obtained by assuming that the spandrels can be replaced by a continuous system of laminae, or small beams. Natural frequencies and mode shapes are determined, the importance of including vertical displacement in the analysis is discussed, and a study of the effect of neglecting the vertical inertia term is given. These cases are illustrated with graphs and with one specific example. Investigations are also made of the asymptotic behavior of the system as the spandrels become weak, as they become stiff, and as the frequencies become large. Finally, the theory of sandwich beams is presented and compared to that for coupled shear walls.

Pub. May 71, 192p., NTIS No. PB-205 267; PC \$3.00 MF \$0.95

SUPPORTED BY California Inst of Technology - Pasadena

3.0046, MEASUREMENT OF DYNAMIC CHARACTERISTICS OF SWITCHYARD EQUIPMENT

A.L. ASKEI, State Dept. of Water Resources, Sacramento, California 95802 (DWR)

The objective of this program is to find means of improving the earthquake resistance of electrical apparatus located in switchyards near the power and pumping plants along the California Aqueduct where major seismic disturbances may occur. In addition, the information obtained will be applied to future designs of a similar nature.

Phase I of the program is to evaluate the seismic response of the electrical apparatus. To accomplish this, a field testing program was undertaken to determine the dynamic characteristics of the following switchyard electrical apparatus: Lightning arrestors, 230 KV air circuit breakers, disconnect switches, coupling capacitor potential device, bus supports, line trap, and oil circuit breaker. This phase of work is completed and was accomplished by the use of a Hewlett-Packard 5525A Laser Interferometer, a recently developed machine, capable of measuring acceleration responses, natural frequencies and damping characteristics. Dynamic field testing of unmodified switchyard electrical apparatus has been basically completed. Additional testing of critical power and pumping plant equipment will be performed.

Phase II work consists of testing some of the aforementioned electrical apparatus with modifications using energy absorbing dampers to improve their earthquake shock resistance. Testing of modified switchyard electrical apparatus using energy absorbing dampers to improve earthquake shock resistance has been underway.

SUPPORTED BY California State Government - Sacramento

3.0047, URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an esti-

mated \$100 billion in annual economic activity, expansive soils, fault hazards, tsunami hazards, and so on. It describes the nature, distribution, and extent of the problem, as well as costs and effective reduction measures, and agencies responsible.

Pub. Jun 73: 111p., NTIS No. PB-222 145

SUPPORTED BY U.S. Dept. of Home Interior

3.0048, COMPARISONS OF SEISMIC RESPONSE OF TWO IDENTICAL STRUCTURES DERIVED FROM THE SAN FERNANDO (ABBREV)

S.A. FREEMAN, John A. Blume & Associates, California

No summary has been provided to the Information Exchange.

Pub. 1972: 26p., NTIS No. CONF-72 09.95

SUPPORTED BY No Formal Support

3.0049, TSUNAMI RESEARCH

S.T. ALGERMISSEN, U.S. Dept. of Interior, Research Laboratories, Boulder, Colorado

Technical objective: Through analysis of tsunami mechanisms, establish the causative mechanisms. Once done, the information can be put into the tsunami warning system to strengthen the warning capability of the system.

Approach: Refine the statistical and physical models of earthquake fault mechanisms are such that meaningful correlation with tsunami can be observed.

Progress: Both the statistical and physical models of earthquake fault mechanisms have been developed. This is being documented in several journal articles.

SUPPORTED BY U.S. Dept. of Commerce

3.0050, TETON DAM SEISMICITY - A STUDY OF THE TETON DAM AREA BEFORE, DURING AND AFTER THE 1929 EARTHQUAKE (ABBREV)

W.V. MICKLEY, U.S. Dept. of the Interior, Research Laboratories, Boulder, Colorado 80302

Compile, study, interpret and report the seismicity of the Teton Dam area before, during and after the 1929 earthquake. To determine if the existing seismicity is a potential hazard to the dam and the area around it.

Provides localized seismic information for the Teton Dam area otherwise unavailable. This would be of value to the overall National Seismicity Studies to determine damaging earthquakes.

SUPPORTED BY U.S. Dept. of Interior

3.0051, NATIONAL EARTHQUAKE INFORMATION CENTER

A.C. TARR, U.S. Dept. of the Interior, Research Laboratories, Boulder, Colorado 80302

The NEIS serves as a focus for seismicity information from an international group of cooperating countries. Three principal services are provided: 1) to users in the scientific, governmental,

collected from a global network of seismograph stations. This forms a data base for a substantial part of research in seismology. 2. Information Services: NEIS performs a clearing-house function for general information about the earthquake phenomena, risk, and other aspects which cannot be provided through routine publications. 3. Earthquake Alerting Service: Provides accurate information on the location, magnitude, and relevance of all large and damaging earthquakes and fills a need for notification to disaster relief agencies, scientists and the public.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0052, COAL MINE DEFORMATION STUDIES, SOMERSET, COLORADO

C.R. DUNRUD, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States in which project pertains: Colorado.

Determine which geologic features and engineering properties of rocks control mine deformation problems, such as (1) subsidence, (2) roof falls, and (3) coal mine bumps or rock bursts, so that future mining can be safer and more efficient, with a minimum of damage to the environment and maximum utilization of coal reserves. 1. Make a detailed engineering geologic map of proposed or current mining areas of the Somerset district, Colorado, at 1:12,000. Map structural and lithologic features and physical properties of coal and rock in selected mine workings, and determine their effects on bumps and rock bursts. 2. Make periodic subsidence measurements and deformation maps or profiles of surface areas above producing coal mines and determine how the processes are controlled by geology and mine geometry. 3. Monitor the seismic activity in the Somerset district and determine its relation to mine deformation and coal production. 4. Study processes of natural arches under various loads and lateral confinement and in various geologic environments to serve as an aid in designing more stable underground openings.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0053, COMPARISON OF COMPUTED AND MEASURED DYNAMIC RESPONSE OF MONTICELLO DAM

L.H. ROEHM, U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado 80225

Abstract: Forced vibration tests were made on Monticello Dam to obtain natural frequencies, mode shapes, and damping ratios for the structure. Outlined is the analytical method used to determine computed values for natural frequencies and mode shapes so that experimental and computed data can be compared. Also compared are crest deflections determined from accelerations measured during the tests with computed deflections. The results of the investigation indicate that the analytical method discussed in the report is satisfactory for estimating earthquake loadings for concrete arch dams, where the loadings include the effects of structural resonance.

Pub. Dec. 71: 16p., NTIS No. PB-205 410; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

served, in other countries, have caused loss of life and significant damage. With increasing population and the corresponding increase in the demand for water and other services, it now seems wise to review all aspects of the problem to determine what additional information is needed to evaluate the hazard. The report summarizes the history of recorded correlations, discusses the scientific considerations, and makes recommendations designed to improve our understanding of the problem. The recommendations concern specific geologic, geotectonic, and seismic studies -- before, during, and after the filling of large reservoirs -- that can provide the required information.

Pub. Jan. 72: 30p., NTIS No. PB-208 327; PC \$3.00 MF \$0.95.

SUPPORTED BY Natl. Academy of Sciences - Washington

3.0055, ENGINEERING ASPECTS OF THE 1971 SAN FERNANDO EARTHQUAKE

H.S. LEW, U.S. Dept. of Commerce, Building Research Div., Washington, District of Columbia 20234

On February 9, 1971, shortly after an earthquake struck the San Fernando, California area, the National Bureau of Standards was requested by the Office of Emergency Preparedness to send a team of engineers to the disaster area for the purposes of making observations and preparing reports relative to structural damages. A team of structural engineers from the Building Research Division, Institute for Applied Technology, National Bureau of Standards, was dispatched immediately to the disaster area.

This report presents the observations of the NBS on-site inspection team (most photographs in this report were taken by the team). The material presented herein is intended to serve as (1) a documentation of damage resulting from the earthquake and (2) as a source document for further studies, research, and recommendations. This is particularly important, as necessary remedial work and restoration have resulted in the removal of evidence that is essential for studies and evaluations.

Pub. 1971: 419p., Building Science Series 40; U.S. Govt. printing office, Wash., D.C.; PC \$3.00.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.B.S.

3.0056, HYDRAULIC, GEOLOGIC & SEISMOLOGIC STUDIES

G. DEBUCHANANNE, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Description: Develop geologic and seismologic criteria for evaluating safety requirements for nuclear plant sites. Develop methods of investigation and map presentation of geologic and seismologic features affecting site evaluation. Compile maps portraying geologic, tectonic, and seismologic features pertinent to site selection and evaluation in areas of coastal California, including offshore areas, and in the Eastern U.S. Acquire and publish knowledge of earthquakes, faults, and propagation and amplification of seismic motions.

SUPPORTED BY U.S. Atomic Energy Commission

3.0057, HAWAIIAN VOLCANO OBSERVATORY

D.W. PETERSON, U.S. Dept. of the Interior, Geological Survey,

in geologic, geophysical, and geotechnical studies. Efforts are being made to improve the understanding of volcanic processes. Eruptions are studied in great detail, including describing and recording eruptive events and associated phenomena, sampling eruptive products, making photographic records, and mapping vents and flows. Seismic activity is continuously monitored by a network consisting of about 36 stations. Several thousand earthquakes are recorded annually, and their locations and magnitudes are determined by computer. Vertical and horizontal ground deformation is measured by regularly reoccupying tilt stations, leveling lines, and a trilateration network of geodimeter stations. Additional geophysical methods include resistivity, electromagnetic, magnetic, and gravity studies. Hypotheses of magmatic history and evolution are developed from petrographic and chemical studies of lava samples. Individual types of study are correlated with one another to learn the relations among eruptive behavior, magmatic composition, crustal deformation, and physical properties of the local and regional crust. Improved understanding of volcanic processes is gradually leading to better forecasting techniques.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0058, QUASI-STATIC LATERAL DESIGN LOADS FOR EARTHQUAKE RESISTANT STRUCTURES

G. ESTRADAURIBE, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

Abstract: Different types of structures including frames, shear walls, box systems, chimneys, towers, masts, etc., were simulated by means of a mathematical model. The structural properties of the model such as mass and stiffness matrices were defined using matrix compression techniques. Equations of motion were then formulated and solved using a digital computer to obtain eigenvalues and eigenvectors. Finally, after performing a modal analysis, quasi-static loads were evaluated for the various responses of interest, namely displacements, accelerations, shears, and overturning moments. These forces were such that when applied to the model they would produce an equivalent dynamic response of the structure. The effect of parameters such as earthquake magnitude, rigidity of the structures, shear-flexural ratio, stiffness and mass distribution, and number of stories, upon the responses of the structure were analyzed independently. From the data obtained, a method of predicting a set of design quasi-static lateral loads that would yield responses greater than or equal to those given by a complete modal analysis was developed. The recommended systematic method of predicting quasi-static loads for earthquake resistant structures is presented and illustrated by means of an example.

Pub. Jun 71: 183p., NTIS No. AD-726 693; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0059, SEISMIC DESIGN OF LOW-RISE BUILDINGS

W.J. HALL, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

Recent earthquakes near metropolitan areas have shown that many aspects of current seismic design and construction procedures, especially for low-rise buildings, need review and possibly improvement. The research outlined will be aimed at developing simplified methods of analysis for low-rise buildings taking into account the interaction, stiffness and ductility characteristics of infilled frames and changes in these properties associated with deformation of the structures.

SUPPORTED BY U.S. Dept. of Defense - Navy

B.O. HARDIN, Univ. of Kentucky, School of Engineering, Lexington, Kentucky 40506

Abstract: Based on numerous tests on a spectrum of disturbed and undisturbed soils, the shear modulus decreases and the damping ratio increases, very rapidly, with increasing strain amplitude. The rate of increase or decrease depends on many parameters, the most important of which are: effective mean principal stress, degree of saturation, void ratio, and number of cycles of loading. Ambient states of octahedral shear stress, overconsolidation ratio, effective strength envelope, frequency of loading, and time effects have a less important influence on these properties. Cohesive soils are affected differently than clean sands. The shear modulus and damping in soils are important to the analysis of all soil vibration problems. Apparatus used to measure these properties must be capable of making accurate measurements at very small shearing strains, the range being defined by practical problems in earthquake and foundation vibrations. A pseudo-static simple shear apparatus and two different resonant column apparatus were used.

Pub. Jul 71: 52p., NTIS No. PB-193 607; MF \$1.65.

SUPPORTED BY U.S. Natl. Science Foundation

3.0061, THE FORMULATION AND EXPERIMENTAL VERIFICATION OF MATHEMATICAL MODELS FOR PREDICTING DYNAMIC RESPONSE OF MULTI-STORY BUILDINGS

M.H. ACKROYD, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

This is the thirteenth in a series of reports covering research supported by the National Science Foundation under Grant GK-27955 and GI-20936, as part of the program for Research Applied to National Needs (RANN).

The study described in this report was aimed at learning how well the dynamic response of buildings can be predicted theoretically, so as to judge the validity of using theory to estimate damage.

In the design of multi-story buildings for lateral loads, the use of mathematical models to predict dynamic response has become an accepted practice. However, the accuracy of the predictions depends primarily on whether the model is formulated correctly for representing characteristics of the actual building. Currently, this formulation is not necessarily a straightforward, well defined process, but depends largely on engineering intuition and experience. This paper surveys the problems experienced in formulation of math models for actual buildings in the past, deduces from these studies suggested modeling guidelines based on success or failure of models investigated. Having proposed guidelines for different types of buildings, a study was made for a 15-story steel frame apartment building in Cambridge, Mass. The study includes experimental measurements of dynamic response to wind over a year's period at various stages of construction, predicted behavior was compared to that observed in the field. Structural and non-structural elements were included to accurately predict response for the small amplitude motion observed.

Pub. May 74: 64p., Seismic Design Decision Analysis Report No. 13; Dept. Civil Engineering, Mass. Inst. of Technology, Cambridge, Mass. 02139 PC \$3.00.

Abstract provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

3.0062, SENSITIVITY ANALYSES AND GRAPHICAL

G. TALEBAGHA, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

This is the fourteenth in a series of reports covering work supported by the National Science Foundation under the program of Research Applied to National Needs (RANN).

A description of the methodology and pilot application to the SDDA problem have already appeared in Report 9. Chapter 2 of this report deals with the sensitivity analyses of the SDDA problem to several parameters. A concise form of the SDDA mathematical formulation using matrix notations is also presented in Chapter 2. A new graphical method for the determination of a suitable design strategy for a given design situation is presented in Chapter 3. Illustrative examples of actual situations are presented in Chapter 4 using the proposed graphical method.

The results of sensitivity analyses of the Seismic Design Decision Analysis problem to the annual risk curve, human life and injury costs and maximum tolerable death rate are presented herein. Two criteria to decision-making were considered: cost-benefit with a dollar cost assigned to life loss and maximum tolerable lives lost ratio.

A new graphical method for the quick determination of a suitable design strategy for a group of buildings of given structural type and general location is presented. The risk curve of the building's location is superimposed on a time-coded graph of standard risk curves and the optimal design strategy is readily determined. As an illustrative pilot application, the method is applied to the choice of optimal design strategies for multi-story reinforced concrete apartment buildings in Boston, Long Beach, and Palmdale for each optimality criteria.

Pub. June 74; 36p., Seismic Design Decision Analysis Report No. 14; Dept. of Civil Engineering, Mass. Inst. of Technology, Cambridge, Mass. 02139.

Abstract provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

3.0063, DAMAGE PROBABILITY MATRICES FOR PROTOTYPE BUILDINGS

R.P. WHITMAN, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

This is the eighth in a series of reports prepared under National Science Foundation Grants GK-27955 and GI-29936.

Starting with this report, a new title has been assigned to the series. Previously the series was called Optimum Seismic Protection and Building Damage Statistics. The new title, Seismic Design Decision Analysis, more aptly indicates the overall objectives of the study. To date, SDDA has been applied only to multi-story buildings. However, the same basic approach can be applied to a wide range of engineered facilities. Use of the words "decision analysis," and omission of the word "optimum," reflects the need to consider human and social values rather than relying solely on cost/benefit analysis.

This report presents damage probability matrices (DPM) for multi-story buildings, developed from various sources by various techniques: Documentation of actual earthquake damage, theoretical analysis, and judgment. This effort was specifically aimed at developing DPM for the pilot application of SDDA to multi-story buildings in Boston. More particularly, the DPM presented in this report are intended to apply to 5 to 20 story buildings with reinforced concrete

similar meanings to the terms UBC O, UBC 1 and UBC 2. Superzone S denotes a lateral force requirement twice that for Zone 3.

Pub. Oct. 73; 82p., Seismic Design Decision Analysis Report No. 8; Dept. of Civil Engineering, Mass. Inst. of Technology, Cambridge, Mass. 02139.

Abstract provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

3.0064, SUMMARY OF METHODOLOGY AND PILOT APPLICATION

R.P. WHITMAN, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

This is the ninth in a series of reports covering work supported by the National Foundation under Grants GK-27955 and GI-29936. The paper reproduced in this report is, in effect, a shortened version of Report 10 scheduled for release at the end of 1973. The development of the damage probability matrices is described in detail in Report 8. This paper describes a procedure for balancing cost and risk called Seismic Design Decision Analysis (SDDA). While the procedure potentially has a broad range of application, this paper focuses specifically upon building code requirements. To illustrate the procedure, a pilot application is presented involving buildings of moderate height in Boston.

Pub. Oct. 73; 54p., Seismic Design Decision Analysis Report No. 9; Dept. of Civil Engineering, Mass. Inst. of Technology, Cambridge, Mass. 02139.

Abstract provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

3.0065, STRUCTURAL MODEL TESTS OF EARTHQUAKE EFFECTS (S 047)

J.P. BALSARA, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Purpose of study/investigation: To investigate the response of a model concrete arch dam to simulated seismic motions. The results will provide information to verify analysis methods for predicting the response of dams to earthquake motions.

Approach in plan: A 1/24-scale model of the North Fork arch dam will be subjected to vibratory loads at the crest and to vibratory and simulated earthquake motions at the base of the dam. The response of the dam will be studied and experimental results will be compared with analytical predictions.

Progress to date: Tests on the model dam using electromagnetic vibrators mounted on the crest have been completed. The vibrators were run in and out of phase and the water level in the reservoir was varied from full to empty. The data will provide information on mode shapes and the damping characteristics of the dam. Preliminary tests using a closed loop, servo-controlled, electrohydraulic vibrator have been successfully conducted. The vibration test was conducted at constant force levels and swept through its frequency range. A three-dimensional grid for a finite element calculation has been set up. The calculations will be conducted using the SAP code and compared with experimental data.

SUPPORTED BY U.S. Dept. of Defense - Army

3.0066, EARTHQUAKE RESISTANCE OF EARTH AND ROCKFILL DAMS

and to perform analytical, laboratory, and field studies for improving current Corps of Engineer design procedures.

Approach: Principal approaches are identified by consultation with various authorities and noted experts in seismology, soils engineering, dynamic analysis methods, laboratory test procedures, and field exploration techniques. Recommended work items are pursued in the laboratory, full-scale verification tests are undertaken, when appropriate, and related theoretical analysis methods are exercised and examined. Methodology for the analysis and design of earth and rock-fill dams during earthquake-induced motion has been developing over the past decade. Reviews of these developments reveal that at least three schools of thought, regarding concept and approach to the problem, are in vogue. The goal, however, of all the methods is to estimate the permanent deformation of earth dams caused by earthquake motions. Knowledge of the residual dam deformation after an earthquake might indicate the need for additional freeboard, a wider crest, flatter slopes, buttressing berms, additional filters, relief wells, etc. Thus, the research plan for this work unit includes continuing personal liaison with recognized authorities in the field of earthquake engineering and pertinent subspecialties in order to assess the pulse-of-the-art, to be aware of advanced thinking and the results of concomitant research on the subject, and to apply the most promising research aspects to Corps design problems. A suite of sophisticated computer software is continually being assembled along with a maturing and unique laboratory testing program to provide quantitative evaluations of dam behavior during earthquakes.

Because the approach to this work unit requires a continuing assessment of the state of the rapidly developing art of earthquake engineering as applied to soil, rock, and earth-rock mixtures, and to the behavior, stability, and safety of structures composed of these materials under earthquake loading, an *a priori* listing and scheduling of sequential steps to the stated objective would be inappropriately dogmatic for the necessarily research-oriented approach required for this work unit. (Text Abridged)

SUPPORTED BY: U.S. Dept. of Defense - Army

3.0067, STUDY OF GROUND SHOCK INDUCED LIQUEFACTION AS A MECHANISM FOR FAILURE OF MILITARY INSTALLATIONS

J.G. JACKSON, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

To determine the effect of percent saturation on wave propagation phenomena in sands, in order to assess the effect of the presence of groundwater on free field stresses and motions caused by a nuclear blast, and to investigate liquefaction potential of soils under the combination of outrunning and locally airblast-induced ground shock. Ground shock due to earthquakes has caused the failure of conventional structures by liquefaction (the formation of a quick-sand condition), the potential of nuclear blast induced ground shock for causing failure of military installations will be investigated. The relevance of this work is the use of its results for constriction of protective structure facilities to prevent such failures and in target analyses as a means of destroying enemy facilities.

A series of wave propagation experiments will be conducted on a medium dense sand in the laboratory. The experiments will

be applied to the soil specimens. Movement of inclusions covering a wide range of density will be monitored in order to detect any tendency for liquefaction to occur. If possible, an experiment will be designed for a future field test.

Supporting agency address information: OCIE Waterways Experiment Station, Vicksburg, Ms. 39180

SUPPORTED BY: U.S. Dept. of Defense - Army

3.0068, STABILITY AND DYNAMIC RESPONSE OF COOLING TOWERS

D.P. BILLINGTON, Princeton University, School of Engineering, Princeton, New Jersey 08540

The first phase of this research will focus on bifurcation stability of thin shells of revolution and will consist of analytical studies on: cylindrical shells under wind loading with free top and elastically-supported base; toroidal shells under uniform pressure and under wind pressure with free top and fixed base; hyperboloids under uniform pressure and under wind pressure for simply-supported boundaries and for free top and fixed base. Included will be numerical (finite element) studies on hyperboloids under uniform pressure and under wind pressure for simply-supported boundaries, for free top and fixed base, and for variable thickness cooling-tower type shells with ring top and flexible base.

The second phase will focus on the non-linear, snap-through analysis for thin shells of revolution as well as on transient earthquake analysis and will consist of numerical (finite element) studies on: non-linear analysis of cylinders and hyperboloids to study the influence of the so-called geometric stiffness effects; application of the non-linear analysis to cooling-tower type shells to develop a snap-through analysis for stability; transient earthquake analysis for cooling-tower type shells to include the influence of spatial variations in ground motion. Additional theoretical work on imperfection analysis for toroids to extend previously published work and to prepare for an analysis of the imperfection sensitivity of cooling-tower type shells will also be included.

SUPPORTED BY: U.S. Natl. Science Foundation

3.0069, REGIONAL EARTHQUAKE RISK STUDY, TECHNICAL REPORT

UNKNOWN, Mississippi Ark. Tenn. Council, Memphis, Tennessee

This report describes the seismic risk in the MATCOG(MDD) area. It is written to serve primarily as an aid in the establishment of a public policy regarding earthquake protection. The risk is stated in terms of potential property damages and life losses. Each decade, from the present to the year 2020, is examined considering present construction methods and/or the introduction of more earthquake resistive construction. The geology and seismic history of the region are reviewed. The probabilities of different intensity quakes and a decision theory rationale are used to evaluate the true risk in terms of expected losses.

Pub. Sept. 74, Miss. - Ark. - Tenn. Council of Govt. Memphis Delta Develop. Dept., 125 N. Main St. Room 518, Memphis Tenn. 38103.

Abstract provided by FDAA.

SUPPORTED BY: U.S. Dept. of Housing & Urban Development

E. BERG, Univ. of Alaska, Geophysical Institute, College, Alaska 99735

Abstract: The main purpose of the contract was to gain insight into the crustal failure mechanism and the associated source phenomenon in Alaska. This effort includes the operation of the short-period telemetry network and the three long-period borehole installations used for the measurements of crustal tilts. Through the telemetry system there is now on hand an almost complete record on the seismicity of Central Alaska, covering a total of four years, and of much higher accuracy than was hitherto available. The operation of the borehole long-period seismometer has revealed tilts associated with earthquakes as small as magnitude 3, which are consistent with the tectonic stress axis, but do not seem to conform to elastic fault dislocation models. Analysis of literature suggests that Russian observations of the V_p/V_s ratio, diminishing by about 0.1 prior to larger earthquakes, can be explained by the decrease in V_p/V_s ratio due to micro-fracturing (observed in the laboratory) and theoretical as well as experimental work on V_p/V_s changed as a function of porosity.

Pub. Jan. 71: 77p., NTIS No. AD-719 840: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0071, EVALUATION OF FEASIBILITY OF MAPPING SEISMICALLY ACTIVE FAULTS IN ALASKA

L. GEDNEY, Univ. of Alaska, Geophysical Institute, College, Alaska 99735

Abstract: The author has identified the following significant results. The sharp bend in the Alaska Range near 65 deg N, 150 deg W is now thought to enclose a corner of the northwesterly migrating north Pacific lithospheric plate. Subduction of the plate beneath the continent is believed, on the basis of hypocentral distribution, to occur along Cook Inlet and the eastern flanks of the Alutian and Alaska Ranges as far northward as Mt. McKinley. The nature of tectonic deformation here, particularly in the area of the bend in the Alaska Range, is understandably complex. The Denali fault is thought to be of a transform character in the vicinity of Mt. McKinley (i.e., it is thought to be the surface along which the oceanic plate separates from the continental plate). On the ERTS-I imagery, however, it appears that there are a number of sub-parallel faults which branch off of the Denali fault in a southwesterly direction. Slippage along these would tend to squeeze material around the inside of the bend rather than the plate being directly underthrust. All of these sub-parallel faults are seismically active. The right-lateral fault-plane solution obtained for this event is consistent with the concept of slippage around the bend on a set of sub-parallel faults in the manner postulated. The best images to show these features are 1066-20444 and 1266-20572.

Pub. Jul 73: 13p., NTIS No. E73-10842: PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

3.0072, INSTALLATION AND OPERATION OF A TELEMETERED SEISMIC NETWORK ON THE ALASKA PENINSULA

UNKNOWN, Univ. of Alaska, Geophysical Institute, Fairbanks, Alaska 99701

3.0073, STIFFNESS DEGRADATION OF REINFORCED CONCRETE MEMBERS SUBJECTED TO CYCLIC FLEXURAL MOMENTS

V. V. BERTERO, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: A method of testing and evaluation of stiffness degradation in the inelastic regions of reinforced concrete beams is presented in this report. Selection, fabrication, instrumentation and testing of specimens are described in detail. Four beams having rectangular cross sections were subjected to different deformation histories including reversed loadings. Test results are presented in terms of hysteresis loops for steel and concrete strains, curvatures and deflection. Effects of deformation history on stiffness, strength, ductility and energy absorption and dissipation are discussed. This report constitutes the first phase of a continuing program of investigation and recommendations for further research are indicated.

Pub. Dec. 69: 128p., NTIS No. PB-202 942: PC \$3.00 MF \$0.95.

SUPPORTED BY University of California

3.0074, THE UNPREDICTABLE DISASTER IN A METROPOLIS - PUBLIC RESPONSE TO THE LOS ANGELES EARTHQUAKE OF FEBRUARY, 1971

L. B. BOURQUE, Univ. of California, Survey Research Center, Berkeley, California 94704

Abstract: A combination of findings on post earthquake public behavior suggests that persons who are outside a certain perimeter following a disaster are given less assistance by disaster agencies and are not defined by others as 'victims' while often experiencing what they themselves consider to be severe emotional damage.

Pub. Jun. 73: 176p., NTIS No. AD-765 513/7: PC \$5.25 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

3.0075, EARTHQUAKE SAFETY OF SCHOOL BUILDINGS

B. BRESLER, Univ. of California, School of Engineering, Berkeley, California 94720

A large number of school buildings are unsafe if subjected to strong motion earthquakes. It has been estimated that in the U.S. the demolition of the old and construction of the new school buildings to replace the unsafe facilities will require an expenditure of several billions of dollars and cause disruption to school sites and ongoing education. While the unsafe buildings do not meet some of the current standards, it may be possible to modify many of these buildings to bring them up to a safe standard. Compared to demolition and new construction, this represents potential saving of about one-half billion dollars, conservation of open space and existing school sites, and preservation of community landmarks. In this study various types of school buildings and typical problems in earthquake safety will be identified and current criteria used in evaluating this safety will be reviewed.

3.0076, EXPERIMENTAL INVESTIGATION INTO THE SEISMIC BEHAVIOR OF CRITICAL REGIONS OF REINFORCED CONCRETE COMPONENTS AS INFLUENCED BY MOMENT AND SHEAR

W. CLIFORD Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: The behavior of reinforced concrete components simulating interior beams with column studs is investigated. The shear span and shear span to depth ratios of each beam, a series of twelve were varied in order to study their influence on energy absorption and stiffness degrading properties. The beams were loaded by using a hydraulically powered, electrically controlled actuator. Similar beams were tested under quasi-static and dynamic conditions. Load-deflection, moment-rotation and shear force-shear deformation types of relationships have been obtained. The results are discussed in terms of energy absorption, stiffness deterioration, strength and deflection ductility. It is concluded that for low moment/shear stress, the spacing requirements of the codes should be relaxed.

Pub. Apr. 73, 185p., NTHS No. PB-215 884/8. PC \$6.00 MF \$0.65

SUPPORTED BY: University of California

3.0077, ADAP: A COMPUTER PROGRAM FOR STATIC AND DYNAMIC ANALYSIS OF ARCH DAMS

RU. CHUGH Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: The development of a finite element computer program for linear static analysis and dynamic earthquake response analysis of arch dam-foundation systems is described. The program uses most of the logical features of the computer program SAP. Three different element types are included in the program, these are considered to be the most suitable elements for use in the three dimensional analysis of arch dam systems. The program generates the finite element mesh of the system from a relatively small amount of input data, performs a static or dynamic analysis of the system and prints out the resulting displacements and stresses. The dynamic part of the program uses special numerical procedures which are shown to be very efficient in the analysis of arch dams. The report includes a brief description of the elements, a study algorithm and the analysis capabilities of the program. Finally the application of the program to the static and earthquake response analysis of the Morrow Point dam is demonstrated.

Pub. Jan. 73, 182p., NTHS No. PB-223 763/4. PC \$11.25 MF \$0.45

SUPPORTED BY: University of California

3.0078, NONLINEAR ANALYSIS OF REINFORCED CONCRETE FRAMES AND PANELS

H. Y. TRINKIN, Univ. of California, School of Engineering, Berkeley, California 94720

Abstract: An analytical procedure is developed which utilizes quadrilateral, linear strain finite elements, special frame elements, axial force rod elements, and bi-directional tie link elements in order to study two-dimensional reinforced concrete frames with attached shear panels which are subjected to three lateral forces. During the incremental loading procedure, allowance is made for the cracking and destruction of concrete elements with redistribution of stresses in the surrounding structure by iterating the solution within each load increment. The tie links are used to connect the

elements under a general constitutive model for describing cracked concrete, but assumes the uncracked elements to be isotropic. Material constitutive relations are not modified for the biaxial stress state. This method of analysis is applied to a set of test examples and to frame-and-panel models. Predictions of cracking, stress patterns, and deformations are compared to experimental results where possible.

Pub. Mar. 70, 275p., NTHS No. PB-191 037. HC \$3.00 MF \$0.65

SUPPORTED BY: U.S. Natl. Science Foundation

3.0079, GENERAL PURPOSE COMPUTER PROGRAM FOR INELASTIC DYNAMIC RESPONSE OF PLANE STRUCTURES

A.E. KANAAN, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: A computer program for the dynamic response analysis of inelastic plane structures of arbitrary configuration is described. The program consists of a series of base subroutines which carry out a step-by-step dynamic analysis. Subroutines for structural elements of a variety of types may be developed independently and added to the base program. Subroutines for arbitrarily oriented truss elements, arbitrarily oriented beam-column elements, infill shear panel elements and semi-rigid connection elements have been developed and are described. The direct stiffness method is reviewed, with particular emphasis on the selection of displacement and deformation degrees of freedom. The step-by-step dynamic analysis procedure for inelastic structures is considered in detail. Instructions to be followed when adding new elements to the program are presented.

Pub. Apr. 73, 146p., NTHS No. PB-224 260/3. PC \$6.00 MF \$0.95

SUPPORTED BY: U.S. Natl. Science Foundation

3.0080, SEISMICITY OF MENDOCINO ESCARPMENT-GORDA RIDGE REGION - CALIFORNIA

E.G. KLIFF, Univ. of California, Seismographic Station, Berkeley, California 94720

Abstract: The aim of the study was to study in more detail the earthquakes in Northern California using enhanced recording facilities. The main interest was in the regional seismicity related to the tectonics of the region of the San Andreas Fault-Coachella and Mendocino escarpments-Cascade and Klamath Mountains; the regional crustal structure related to earthquake depth and mechanism; and the seismic risk of Northern California.

Pub. Sep. 71, 15p., NTHS No. AD-739 759. PC \$3.00

SUPPORTED BY: U.S. Dept. of Defense - Navy

3.0081, CONSTITUTIVE MODELS FOR CYCLIC PLASTIC DEFORMATION OF ENGINEERING MATERIALS

J.M. KELLY, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Incremental methods are currently being developed to solve transient problems of structures subject to earthquake excitation. A general continuum theory of dislocation motion is used to investigate the response of crystalline solids to cyclic straining in uniaxial tension and compression. For macroscopically homogeneous deformation under uniaxial stress a simple one-dimensional equation suffices to relate the plastic strain rate to dislocation flux. The material is characterized by evolutionary equations for multiplication

exhibit respectively a Bauschinger effect, isotropic hardening and isotropic softening when subjected to a program of alternating strains at constant rate

Pub. Sep. 73: 22p., NTIS No. PB-226 024/8; PC \$3.50 MF \$1.45

SUPPORTED BY University of California

3.0082, INELASTIC BEHAVIOR OF STEEL BEAM-TO-COLUMN SUBASSEMBLAGES

H. KRAVINKLER, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: A thorough experimental investigation of a column with two beams framing into it, was carried out. The selection of a model suitable for laboratory testing is discussed, and a description of the experimental setup and the testing procedure is presented. The experimental data obtained include the section properties, loading histories, comprehensive tables of all load and deformation parameters, load-deformation hysteresis diagrams, deformation fields and strain (stress) distributions in the connection areas. A detailed interpretation of the test results is presented, including an evaluation of the significance of the most important geometrical and loading parameters with respect to strength, stiffness and ductility. The effect of these parameters on the energy absorption capacity and energy dissipation is studied.

Pub. Oct. 71: 306p., NTIS No. PB-211 435; PC \$6.00 MF \$0.95

SUPPORTED BY University of California

3.0083, INFLUENCE OF BASE ROCK CHARACTERISTICS ON GROUND RESPONSE

J. LYSMER, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Specifically the investigation involved a study of the effect of the deformability of the rock underlying nine different soil deposits, ranging in thickness from 50 to 300 ft, on the acceleration amplitude and frequency characteristics of the motions developed in the rock and at the surface of the deposits.

Pub. Nov. 70: 35 p., NTIS No. PB-197 897; PC \$3.00 MF \$0.95

SUPPORTED BY University of California

3.0084, RATE OF LOADING EFFECTS ON UNCRACKED AND REPAIRED REINFORCED CONCRETE MEMBERS

S.A. MAHIN, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: The effect of high loading rates on the behavior of reinforced concrete structures and the effectiveness of the epoxy injection technique of repairing cracks in such structures have been studied through tests on six simply-supported, doubly-reinforced, concrete beams. Zones of time-varying moment were developed in the specimens by imposing the same displacement histories, if the third cycle of the

Pub. Dec. 72: 164p., NTIS No. PB-224 520/7; PC \$10.00 MF \$1.45

SUPPORTED BY University of California

3.0085, ELASTIC-PLASTIC EARTHQUAKE RESPONSE OF SOIL-BUILDING SYSTEMS

J. AHN-AM, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Effects of plastic soil deformation on the earthquake response of buildings using elastic-plastic finite element models are presented. Non-uniform support excitations were generated statistically to reflect the soil-layer formation of downtown Tokyo. The lumped mass model of the building is attached through a massless rigid mat to the soil which is represented by a set of finite elements arranged in three rows, representing two typical soil layers of downtown Tokyo. Numerical results of elastic-plastic analyses for 3, 9 and 18 story buildings with and without basements were compared with those of the corresponding elastic systems as well as buildings with the base fixed at the ground level.

Pub. Aug. 72: 164p., NTIS No. PB-214 868/2; PC \$6.00 MF \$0.95

SUPPORTED BY University of California

3.0086, INVESTIGATION OF HIGHWAY BRIDGE DESIGN METHODOLOGY FOR PROVIDING STRUCTURAL RESISTANCE TO EARTHQUAKES

PENZIEB, Univ. of California, School of Engineering, Berkeley, California 94720 (021011) (TRAIS)

Existing bridge design methodology for providing seismic resistance will be evaluated. A more rational approach will be developed and recommendations made for correcting any deficiencies found in existing specifications.

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SUPPORTED BY U.S. Dept. of Transportation - FHWA

3.0087, THREE DIMENSIONAL STOCHASTIC MODELLING OF STRONG EARTHQUAKE GROUND MOTIONS

J. PENZIEB, Univ. of California, School of Engineering, Berkeley, California 94720

The objective of the research is to establish three-dimensional stochastic models of strong earthquake ground motions which include the effects of local soil conditions, magnitude, epicentral distance, and depth of focus. These models are nonstationary in character and possess statistical properties which are consistent with those of real earthquakes.

The properties are being established through statistical analyses of strong ground motion data. Covariance and cross-correlation functions are being generated for the individual and component pairs, respectively, of recorded ground motion accelerations. The random characteristics of magnitude and direction of the time dependent resultant acceleration vector are being examined with respect to soil conditions, etc.

Various reinforced concrete cantilever beams discussed were 15 m by 29 m in cross-section. All had six No. 9 deformed bars for longitudinal reinforcement at the top and bottom. The shear reinforcement differed in size and spacing for each specimen. With heavy longitudinal reinforcement and small cantilever length (78 m), high shearing forces were transmitted simultaneously with the bending moments. The objective was to study the effects of the high shear forces on deformation, strength, stiffness and energy dissipation capacity of flexural members.

Pub. Oct. 72, 90p., NTIS No. PB-214 555/5, PC \$3.00 MF \$0.95

SUPPORTED BY University of California

3.0089, CYCLIC LOADING OF FULL-SIZE CONNECTIONS

J. P. POPOU, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: A series of eight tests of large full-size steel beam-to-column connections subjected to cyclic loading simulating earthquake effects on a building frame have been performed. All beams were made of A36 steel. The connections of the beam to column stubs were either of the all welded type, or of welded flanges and bolted web types. The principal objective of the work was to determine the behavior of these two types of connections under severe cyclic loading well into the elastic range and to assess the difference in their performance. All connections showed strengths in excess of capacities determined by the simple plastic theory, i.e., without regard to strain hardening. The hysteresis loops in all cases were remarkably stable in shape under repeated loading cycles. All-welded connections showed excellent ductility. The bolted web-welded flange type connections also behaved well, but were less ductile.

Pub. Dec. 70, 62p., NTIS No. PB-213 545/9, PC \$5.25 MF \$0.95

SUPPORTED BY University of California

3.0090, OPTIMUM DESIGN OF EARTHQUAKE-RESISTANT SHEAR BUILDINGS

D. RAY, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: The report is the first of a series of studies concerned with identification and simulation of the response of multistory framed buildings as a function of design variables and earthquake ground motion. A methodology is developed via optimization theory, in which concepts of objective function, behavioral constraints and system dynamics are given a mathematical structure upon which optimal synthetic design, application to one-bay, multistory, unbraced frames is discussed to illustrate the methodology. Minimum volume of column sections is taken as the objective, along with the constraint that the structure should respond elastically with limited relative story drifts under moderate earthquakes. System dynamics appropriate to a shear-type building frame is adopted along with ground motion characterized by standard pseudo-velocity response spectra.

Pub. Jan. 74, 102p., NTIS No. PB-231 172/8, PC \$4.50 MF \$1.45

SUPPORTED BY U.S. Natl. Science Foundation

3.0091, DYNAMIC BEHAVIOR OF A HIGH-RISE DIAGONALLY BRACED STEEL BUILDING

H. REA, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

modal modes in both the E-W and N-S directions. In its first two torsional modes by means of eccentric type vibration generators. A mathematical model of building for E-W translational motion was formulated from the structural drawings. Various parameters in the model were adjusted until resonant frequencies and mode shapes matched the corresponding experimental values. One significant conclusion of the study was that in order to match the mode shapes accurately, the effects of the walls, the central core, and foundation compliance had to be included. The final phase of the investigation was the determination of the response of the mathematical model to various amounts of damping up to 5% of critical) to the 1940 Centin earthquake ground acceleration.

Pub. Aug. 71, 107p., NTIS No. PB-203 584/ PC \$3.00 MF \$0.95

SUPPORTED BY University of California

3.0092, ACCELERATIONS IN ROCK EARTHQUAKES IN THE WESTERN UNITED STATES

P.B. SCHINABEL, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Maximum accelerations records on rock sites during earthquakes in the Western part of the United States are summarized, and attenuation curves showing the decay of maximum acceleration with increasing distance from the zone of energy release are developed for different magnitudes of earthquakes. Changes in acceleration level and predicted periods of rock motions with distance are also analyzed. The significance of maximum acceleration level as an indicator of intensity of ground shaking is discussed.

Pub. Jul. 72, 33p., NTIS No. PB-211 100/1, PC \$3.00 MF \$0.95

SUPPORTED BY University of California

3.0093, MODIFICATION OF SEISMOGRAPH RECORDS FOR EFFECTS OF LOCAL SOIL CONDITIONS

P.B. SCHINABEL, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: A procedure for modifying the time history of seismic records for the effect of local soil conditions is presented. The method is based on a conventional one-dimensional wave-propagation approach with nonlinear soil properties extended to practical use for motions through the Fast Fourier technique. The validity of the approach is tested against the motions recorded at soil sites and one rock site during the 1957 San Francisco earthquake. The good agreement between the computed and recorded values indicates that rock motions can be estimated from motions recorded on soil deposits, and that the pure rock motions in turn can be used to predict the motions that would have been recorded under different soil geological conditions. The method is also used to estimate the probable rock motions in the vicinity of the 1940 Centin earthquake of 1940 and the ground surface motions that could have been developed on various soil conditions in the same general area.

Pub. Dec. 71, 33p., NTIS No. PB-214 450/9, PC \$3.00 MF \$0.95

SUPPORTED BY University of California

3.0094, EFFECTS OF SOIL CONDITIONS ON GROUND MOTIONS DURING EARTHQUAKES - ALASKA, CALIFORNIA

H.B. SEED, Univ. of California, Inst. of Trans. & Traf. Engin., Berkeley, California 94720

Investigation was initiated in order to develop a better understanding of the regional distribution of shaking intensities, during earthquakes. Methods of assessing the response of soil deposits have been developed and used to analyze the ground motions recorded during earthquakes in San Francisco (1967), Mexico City (1962), Anchorage, Alaska (1964), Osaka, Japan (1964) and Tokyo, Japan (1963). The analytical techniques have advanced to the point where they are being incorporated in design studies of significant structures.

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SUPPORTED BY No Formal Support Reported

3.0095, ANALYSIS OF THE SLIDES IN THE SAN FERNANDO DAMS DURING THE EARTHQUAKE OF FEBRUARY 9, 1971

H.B. SEED, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: The conditions leading to the slides in the San Fernando Dams during the earthquake of Feb. 9, 1971 are described, together with the results of detailed field and laboratory studies conducted to determine the properties of the construction materials and the causes of the slides. The mechanism of sliding in the Lower Dam is reconstructed and it is shown that failure of the upstream slope resulted from a loss of strength in the soils near the base of the embankment. The results of dynamic analyses of the dams are presented and shown to be in reasonable accord with the observed performance.

Pub. Jun. 73: 314p., NTIS No. PB-223 402/9: PC \$17.75 MF \$1.45.

SUPPORTED BY University of California

3.0096, SOIL MODULI AND DAMPING FACTORS FOR DYNAMIC RESPONSE ANALYSES

H.B. SEED, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: The report summarizes the available data concerning the shear moduli and damping ratios for soils. Clearly more data on these dynamic characteristics is required, particularly for silts, clays and gravelly soils. However it is hoped that the data presented will serve as a useful guide in the selection of soil properties for dynamic response analyses and that other engineers might be encouraged to make available any additional data which would supplement that presented above.

Pub. Dec. 70: 45p., NTIS No. PB-197 869: PC \$3.00 MF \$0.95.

SUPPORTED BY University of California

3.0097, A SIMPLIFIED PROCEDURE FOR EVALUATING SOIL LIQUEFACTION POTENTIAL

H.B. SEED, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Catastrophic failures in recent earthquakes have provided a sobering reminder that liquefaction of sandy soils as a result of earthquake ground shaking poses a major threat to the safety of civil engineering structures. Major landslides, lateral movements of bridge supports, settling and tilting of buildings, and failure of waterfront retaining structures have all been observed in recent years as a result of this

liquefaction potential and to compare the results of the method with a number of cases in which liquefaction is known either to have occurred or not occurred in the past. Pub. Nov. 70: 43p., NTIS No. PB-198 009: PC \$0.95.

SUPPORTED BY University of California

3.0098, ANALYTICAL INVESTIGATIONS OF THE SEISMIC RESPONSE OF LONG MULTISPAN HIGHWAY BRIDGES

B. TSENG, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: Descriptions are given to the analytical investigation of the seismic response of long, multiple-span highway bridge structures of the type which suffered heavy damage during the San Fernando earthquake of February 9, 1971. A linear and nonlinear mathematical modelling of the bridge structural system is presented. A three-dimensional elasto-plastic flexural column model suitable for the simulated inelastic behavior of reinforced concrete columns is described in detail. A nonlinear moment-rotation model for simulating the nonlinear discontinuous behavior of bridge expansion joints is also presented. Then, a comparison of linear and nonlinear analytical procedures are described for determining the seismic response of this type of bridge structure.

Pub. Jun. 73: 223p., NTIS No. PB-227 816/6: PC \$1.45.

SUPPORTED BY University of California

3.0099, STATIC AND EARTHQUAKE ANALYSIS OF THREE-DIMENSIONAL FRAME AND SHEAR WALL BUILDINGS

E.L. WILSON, Univ. of California, Earthquake Engin. Res. Ctr., Berkeley, California 94720

Abstract: A procedure and a computer program are presented for the linear structural analysis of frame and shear wall buildings subjected to both static and earthquake loads. The building is idealized by a system of independent beam and shear wall elements interconnected by floor diaphragms which are rigid in their own plane. Within each element, bending, axial and shearing deformations are considered. Beams and girders may be nonprismatic and beams may have shearing deformations included. Also, shear walls may be considered. Finite column and beam widths are included in the formulation. Nonsymmetric, nonrectangular buildings which have frames and shear walls located arbitrarily can be considered.

Pub. May 72: 94p., NTIS No. PB-212 904/7: PC \$0.95.

SUPPORTED BY University of California

3.0100, RECONNAISSANCE STUDY OF RECENT GROUND WATER

L.C. DUTCHER, U.S. Dept. of the Interior, Geological Survey, Garden Grove, California 92643

Imperial Valley, California is a geothermal area with potential for developing energy for power, desalination and irrigation. Shallow and deep wells in the 2,500 sq. mile area indicate greater than normal temperature. Geothermal development is in the Bittles Field at the Salton Sea and at Cerro Prieto, 55 miles south of Mexicali, Mexico. Exploratory drilling by the Bureau of Reclamation and the U.S. Geological Survey is continuing in the area.

The purpose of the study is to estimate the total amount of water in storage, and the amount of total recoverable water in storage in the sedimentary basin with salinity equal to or less than that of sea water (35,000 mg/l). A principal use of this information will be to estimate the magnitude of the local geothermal energy resource. Meeting these objectives will require developing a conceptual model of the geohydrology of the cold, warm and hot flow systems in the basin, and may necessitate future studies.

Collection for analysis and study of pertinent available geological, geophysical, and hydrologic data, including well logs. Formulation of a conceptual model of the sedimentary basin. Estimate water in storage, recoverable and nonrecoverable, of sea water of better quality. Describe possible hazards which might accompany water production, including land subsidence, seismic activity. Appraise and develop future work programs. A report will be prepared.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0101, RECOMMENDATIONS DEVELOPED FROM REPORTS OF THE EARTHQUAKE COMMISSION AND EARTHQUAKE TASK FORCES - SAN FERNANDO EARTHQUAKE (ABBREV)

UNKNOWN, Los Angeles Co. Bd. of Supvs., Los Angeles, California

After the San Fernando earthquake of February 9, 1971, the Los Angeles County Board of supervisors promptly appointed a seven-member Earthquake Commission comprised of leaders in the fields of engineering, seismology and construction. They were asked to examine the effects of the earthquake, assemble facts, draw conclusions and make recommendations for corrective actions to be taken in anticipation of future earthquakes. In its 1971 report, the County Earthquake Commission made broad recommendations in 15 identified areas of multi-jurisdictional concern.

Six wide representative Task Forces, with County department heads as chairmen, were then appointed to study solutions and submit specific recommendations on what must be done and how. This report outlines primarily the County's actions and progress in implementing the various Earthquake Task Force recommendations.

Pub. June 73. 43p. No copy info. available.

Abstract provided by FDAA

SUPPORTED BY No Formal Support Reported

3.0102, OPTIMIZATION OF WATER RESOURCE SYSTEMS INCORPORATING EARTHQUAKE RISK

C.M. DUKE, Univ. of California, School of Engineering, Los Angeles, California 90024

An interdisciplinary effort is being made to develop and validate a methodology for incorporating seismic hazard into the decision making process in the planning and design of water resource systems. Knowledge from the fields of earthquake engineering, water resource engineering and systems engineering is applied. The earthquake forces from violent shaking and surface fault displacement are considered. Cost functions are being developed for various water system elements in terms of the intensity of shaking and the amount of fault movement, as well as in terms of repairing seismic damage. The intensity of shaking is expressed in the form of probability maps. The basic system analysis tool of the methodology is semi-Markov decision processes. The

SUPPORTED BY U.S. Dept. of Interior - O. W.

3.0103, SOIL LIQUEFACTION DURING EARTHQUAKES

K.L. LEE, Univ. of California, School of Engineering, California 90024

The objective is to obtain further information on soil behavior under cyclic loading which more closely simulates the stresses induced in soil elements in the earthquakes and thus reduce the number of approximations and uncertainties involved in seismic stability analyses of structures. Two separate cyclic loading effects are being studied which go beyond the current practice: (1) application of a more realistic train of irregular cyclic loading, and (2) application of cyclic stress waves in different directions instead of the current practice of uniaxial, or plane strain cyclic loading.

SUPPORTED BY U.S. Natl. Science Foundation

3.0104, MICROEARTHQUAKE MONITORING IN THE ANGELES AREA

T. TENG, Univ. of Southern California, School of Engineering, Los Angeles, California 90007 (14-08-0001-12290)

To conduct a microseismicity study of the Baldwin Hills fault in the Newhall-Inglewood area in order to evaluate the potential hazards and determine relative importance of seismicity in the area due to the influence of oil field subsidence and natural tectonic processes.

Seismic stations are being installed in the vicinity of the Baldwin Hills. Data from these stations is telemetered to a central recording and analysis center. Seismic events are being located and compared with patterns of fluid injection in the Inglewood oil field.

Supporting agency address information: Defense Research Projects Agency, Arlington, VA. 22204

SUPPORTED BY U.S. Dept. of Defense - D.A.R.

3.0105, RELATIVE ACTIVITY OF MULTIPLE STRANDS - CALIFORNIA

M.G. BONILLA, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The objective is to obtain data on the detailed geologic sequence of recent movements on adjacent multiple strands of active faults. Data will be sought to determine (1) the width affected by the principal rupture and by subsidiary ruptures, (2) the relative rate of displacement on the multiple strands, and (3) the shift or persistence of activity on the multiple strands.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0106, SANTA CRUZ COUNTY COOP

E.E. BRADB, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California.

This study is undertaken to provide basic data necessary for the preparation of the Seismic Safety Element of the County General Plan. Since sufficient data is presently available regarding flood plains and areas susceptible to seismic waves, it is the purpose of this study to provide a

MAJOR DISASTER TYPES

broad evaluations of consultant reports in support of development projects. Additionally, the geologic information provided by the study will help in identifying or anticipating fault and landslide problems, and will thus indicate where special needs exist for further and more detailed investigations.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0107, EARTHQUAKE HAZARD REDUCTION, SAN FRANCISCO BAY REGION

E.E. BRABB, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California

Identify, characterize and map the earthquake geologic hazards of the San Francisco Bay region. Develop criteria for recognition of geologic materials subject to landsliding, liquefaction and other ground failures resulting from earthquakes and refine techniques of estimating ground response to earthquakes for different geologic settings and seismic base motions. Prepare an active earthquake data system to compute local seismicity, ground base motion, natural period and amplification spectrum for ground materials, as well as probabilities of liquefaction, compaction, lateral spreading, landsliding and surface displacement along faults. This data system would provide the ability to quickly prepare and update regional or local seismic risk maps for planners and others concerned with earthquake hazards in the Bay region.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0108, REGIONAL GEOLOGICAL FRAMEWORK, NORTH CENTRAL SAN ANDREAS FAULT - CALIFORNIA

E.E. BRABB, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

Determine the regional geology along the San Andreas fault at a scale of 1:125,000

Provide geologic framework for San Andreas Fault System at mapping scales commensurate with needs for topical geological studies, geophysical investigations, and seismological studies: 1. Regional tectonic framework of entire San Andreas fault zone at scale 1:125,000. 2. Three-dimensional geologic transects across San Andreas fault zone at 1:62,500 and 1:24,000. 3. Prepare maps showing trace of major faults; e.g., 1906, 1857, 1941. 4. Prepare maps showing width of San Andreas fault zone. 5. Detailed mapping in sites selected for geophysical instrumentation.

Project area is from San Francisco to Hollister and from the Pacific Ocean to the Diablo Range.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0109, ENVIRONMENTAL GEOLOGY OF THE SAN FRANCISCO BAY REGION - CALIFORNIA

E.E. BRABB, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The interpretation of earth science data for land-use planning. Emphasizes earthquake hazard reduction, coastal erosion, slope stability, and engineering properties of hillside and flat-land materials.

This project involves measurement of fault slip in tectonic aseismic creep or otherwise, and other related problems including near-field strain response during both failure and non-failure intervals. Interpretation of results and the investigations related to fault creep are also within the scope of the project. The objectives of the research are to determine tectonic processes within the fault zones, to develop theories concerning the mechanics of such processes, to seek evidence of fault zone activity that might be useful for earthquake prediction or for modification of behavior.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0111, SAN ANDREAS FAULT - CALIFORNIA

M.M. CLARK, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California

The purpose of this project is to produce strip maps of 1:24,000 or smaller that will show the location and briefly describe the most recently active trace of the San Andreas fault in California, other than the San Andreas, that are probably active. The map of the Garlock fault is intended for 1973 and that for the Elsinore fault is intended for 1974. Work on the San Andreas fault southeast of the San Geronimo Pass and on the complex fault system of the eastern Sierra Nevada will extend into 1973 or later, depending on the results of other investigations. Other active faults in California will be mapped in succeeding years.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0112, SOUTHERN CALIFORNIA TECTONICS

M.M. CLARK, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California

This project attempts to characterize the surface geology and recent geologic history of the southern San Andreas fault system, including the Garlock, Sierra Nevada, Elsinore, and parts of the San Andreas faults. The products are 1) strip maps at 1:24,000 showing the most recently active traces of these faults, and 2) detailed studies of the late Pleistocene and Holocene history of movement as shown in stratigraphy, structural geology, and geomorphology. The map of the Garlock fault is intended for 1973 and that for the Elsinore fault is intended for 1974. Work on the San Andreas fault southeast of the San Geronimo Pass and on the complex fault system of the eastern Sierra Nevada will extend into 1974 or later, depending on the results of other investigations. Other active faults in California will be mapped in succeeding years.

Detailed studies of specific parts of the San Andreas and Sierra Nevada fault systems are planned to determine the late Pleistocene and Holocene history of movement on these faults.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0113, REGIONAL TECTONIC ANALYSIS OF THE SAN ANDREAS FAULT - INVESTIGATION OF THE 1906 EARTHQUAKE, APRIL 8, 1906 - CALIFORNIA (ABBREV)

M.M. CLARK, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

tonic activity in the fault zone and (5) investigate the relation of the fault to intricate folding in adjacent strata. Field work is complete for the resulting contributions to the Professional Paper about the earthquake.

However, parts of the fault continue to move, leading to enlargement of the 1968 breaks and creation of new breaks. Furthermore, surficial processes have not yet entirely erased individual ruptures in the areas in which creep appears to have ceased. Thus periodic field investigations along the fault will continue as long as the surface traces display significant and measurable changes.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0114. EARTHQUAKE MODELING

J.H. DIETERICH, U.S. Dept. of the Interior, Geological Survey, *Mento Park, California 94025*

The overall goal this project has is to study the mechanical interactions associated with faulting and related earthquake source mechanics. The approach that is being followed attempts to determine the various interrelations between material parameters, small scale (laboratory) mechanical processes, earthquake source characteristics and long-term strains in the vicinity of shallow faults. Work thus far accomplished has employed one-, two-, and three-dimensional numerical models that simulate the quasistatic and dynamic motions of earthquake sequences. Topics that have been examined with these models include triggering of earthquakes by fluid injection, near-field ground motions, modeling of aftershocks, scaling laws for source parameters, relationship between source parameters and fault friction parameters, and dilatancy.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0115. EARTHQUAKE CONTROL EXPERIMENT - MINNESOTA

J.H. DIETERICH, U.S. Dept. of the Interior, Geological Survey, *Mento Park, California 94025*

Studies of earthquakes related to fluid injection at Rangely, Colorado, and elsewhere have shown that the effective stress law for shear failure of rocks is applicable on a large scale. Numerical modeling indicates that it is at least theoretically possible to control earthquakes by limiting the maximum length of the rupture surface through proper control of fluid pressures on the fault. The purpose of this experiment is to study the problem in detail by conducting tests on artificial faults in large blocks about 26 feet long in a quarry at Cold Springs, Minnesota. A rectangular block of granite will be separated from the surrounding rock and loaded along its boundaries by large hydraulic flatjacks. Stresses to 300 bars on the fault surface can be obtained by this method. Length of the fault rupture will be controlled by fluid injection. Displacements, velocities, and accelerations at the fault and in the near field will be measured during the slip events. In addition, evidence for precursory velocity changes and resistivity changes will be sought.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0116. MONTEREY BAY - CALIFORNIA

H.G. GREENE, U.S. Dept. of the Interior, Geological Survey, *Mento Park, California 94025*

The Monterey Bay project is concerned with the geophysical and geological mapping of Monterey Bay, Monterey Canyon

profiling with a high resolution, .6 to 1 kj sparker, intermediate penetration, 13 to 33 kj sparker, high powered, 160 kj sparker, magnetic profiling with a marine proton precession magnetometer, and gravity profiling with a sulphuric stable platform marine gravimeter, is being done presently. Interpretation of the geological data which consist of bedrock and sediment samples collected by dredging, gravity coring, vibracoring, and in situ sampling with a research submersible are continuing.

Principal objectives of this project are (1) to seismically map the geologic structures of Monterey Bay, to establish geology of the bay, its structure and tectonic history; genesis, thickness and depositional history of the sediments of the bay, (2) to determine the distribution and locations of fresh water aquifers in the northern portion of the bay, (3) to determine the origin of Monterey Submarine Canyon and its significance as it relates to the geology of the bay, (4) to map faults in Monterey Bay and along the shelf from Point Sur to Ano Nuevo Point and determine their significance as they relate to onshore geology, recent seismic events, and modern day working hypothesis such as sea-floor spreading, and (5) to delineate geologic hazards such as locations of slumps and possible submarine landslides. Areas of possible economical interests, such as sedimentary structures that may contain hydrocarbons and locations of possible commercially available sand and gravel deposits have been identified.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0117. INSTRUMENTAL STRAIN - CALIFORNIA AND NEVADA

M.J. JOHNSTON, U.S. Dept. of the Interior, Geological Survey, *Mento Park, California 94025*

The instrumental strain project is aimed primarily at determining the near-field modes of strain accumulation and release associated with earthquakes on active faults in the western United States. We believe this to be a necessary prerequisite for understanding and predicting earthquakes. The instruments used in present include: (1) ten tiltmeters, three strainmeters, and eight magnetometers installed along 80 km of the most active section of the San Andreas, (2) Portable differential magnetometers used at 106 sites along more than 1,000 km of the major faults in California and Nevada.

Unless major problems are encountered, these instruments should be increased to 15 tiltmeters, 6 strainmeters, and 10 magnetometers by next summer. Several new techniques are under development which should increase further our ability to obtain easily, basic information on the earth's crust in seismically active areas.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0118. ENGINEERING SEISMOLOGY - CALIFORNIA

W.B. JOYNER, U.S. Dept. of the Interior, Geological Survey, *Mento Park, California 94025*

States to which project pertains: Current work is concentrated in California but project results will be applicable to all seismically active areas.

The goal of the Ground Motion studies project is to develop reliable methods for predicting the amplitude and other characteristics of earthquake ground motion and how those characteristics vary in different geologic environments. Current work is concentrated on studying the amplification of ground motion by near-surface, unconsolidated materials. Work on-

bedrock input motions and how they depend on geologic conditions, and (3) seismic field experiments to measure the parameters needed for extrapolating the results of small motion recording into the strong-motion range.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0119, MICROEARTHQUAKE DATA ANALYSIS

W.H. LEE, U.S. Dept. of the Interior, Geological Survey, *Menlo Park, California* 94025

In this project we develop methods and techniques for processing and analyzing seismic data recorded by microearthquake network of seismograph stations. Results from this project are accurate locations of earthquakes, their magnitudes and focal mechanisms. We can then relate these results to geologic features of the region under study to map out the active faults in details. In addition, we can study seismic precursory phenomena useful for earthquake prediction.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0120, MONTEREY-POINT REYES (EARTHQUAKE) - CALIFORNIA

D.S. MCCULLOCH, U.S. Dept. of the Interior, Geological Survey, *Menlo Park, California* 94025

The structure of the continental margin between Monterey Bay on the south and Point Reyes on the north is dominated by a northwest-trending belt of rocks composed of continental crust (Silurian block) that is separated from oceanic crust on the east by the active San Andreas fault system, and on the west by the Sur-Nacimiento fault. Recent marine investigation has shown extensive faulting within this crustal block - some of which has offset Holocene deposits. First motion studies of earthquakes that lie on the newly delineated faults within the block indicate right lateral strike slip displacement similar to the adjacent San Andreas fault. Onshore geologic investigation has shown additional evidence for recent faulting, and a long history of continuous deformation of elevated Holocene marine terraces.

The cities of Monterey and Santa Cruz lie adjacent to the coast, and the proximity to the heavily populated areas of the San Francisco peninsula has started to create considerable development pressure along the coast - new port facilities, atomic power plants, residential areas. This program is designed to use geophysical and bottom sampling techniques to establish the fault history of the area, which can then be used as the basis for predicting the seismic hazard in this area.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0121, PALO ALTO, SAN MATEO, AND MONTARA MOUNTAIN 7-1/2-MINUTE QUADRANGLES AND VICINITY, CALIFORNIA

E.H. PAMPEYAN, U.S. Dept. of the Interior, Geological Survey, *Menlo Park, California* 94025

States to which project pertains: California.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0122, ALASKA GEOLOGIC EARTHQUAKE HAZARDS

G. PLAFKER, U.S. Dept. of the Interior, Geological Survey, *Menlo Park, California* 94025

States to which project pertains: Alaska.

The specific project objectives are to reduce and evaluate risk in Alaska from tectonic displacement, seismic shaking, and secondary geologic effects. A more general goal is to gain an insight into tectonic processes within the seismically active zone of southern Alaska.

Initially, research efforts will be concentrated in the highly seismic southern part of the State where most of the population and economic development are concentrated. This research will later be extended into the southeastern and central parts of the State. Geological research under this project will be closely coordinated with parallel geophysical projects by the Office of Earthquake Research.

The geologic studies will involve: 1) preparation of detailed maps of active surface faults and evaluation of geologic evidence for late Cenozoic fault movement; 2) delineation of coastal areas that may be subjected to major earthquakes characterized by large-scale regional tectonic elevation changes and assessment of the hazards related to such movements (notably seismic shaking, tsunamis, seiches, and regional warping); 3) identification and evaluation of secondary geologic hazards related to seismic shaking in critical areas of high population density and along transportation routes (such as landsliding, submarine sliding, liquefaction, landsliding and compaction); and 4) preparation (with OERCS) of a synthesis of pertinent data on the tectonic processes in the seismically active junction between the transform fault system in southeastern Alaska and the northeastern extension of the Alaskan arc tectonic regime into south-central Alaska, to provide a broad framework within which earthquake hazards in southern Alaska can be evaluated.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0123, RANGELEY - CALIFORNIA

C.B. RALEIGH, U.S. Dept. of the Interior, Geological Survey, *Menlo Park, California* 94025

The project was designed to test the hypothesis relating fluid pressures to earthquakes. The project involves precise determination of the location and frequency of earthquakes in the oil field. Fluid pressures are well determined through direct measurement and computer simulation of the reservoir history. The hypothesis relates fluid pressure and the state of stress in the rock to failure strength of the rock. Measurements of the state of stress are therefore being carried out. The purpose of the project is two-fold: 1) to determine whether modification of earthquakes on active faults is possible and the best way to accomplish this, and 2) to prevent the inadvertent triggering of earthquakes by subsurface fluid injection.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0124. REGIONAL AND DETAILED GRAVITY STUDIES IN TECTONICALLY ACTIVE AREAS - CALIFORNIA

S.L. ROBBINS, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The main objective is to use gravity as a tool to aid in the geologic interpretation in tectonically active areas. This includes 1) Calculations of depths to basement in alluviated areas, particularly in or near urban developments, 2) Detailed studies across faults in an attempt to trace them beyond their presently known locations, and 3) to uncover other structural features that are presently unknown.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0125. SPECIAL MICROEARTHQUAKE NETWORKS - ALABAMA AND TEXAS

J.C. ROLLER, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

This project is part of a larger program of research which is directed to the study of earthquakes related to fluid injection or reservoir loading. The current phase of the project is primarily data gathering to establish the background seismicity in areas where future injection of fluid in wells and new reservoirs are planned. The project at present consists of recording earthquake activity from two small seismic networks near Tuscaloosa, Alabama and near Childress, Texas where all injection wells have been drilled and fluid injection will begin in the near future. Future work will investigate the level of seismicity associated with fluid injection.

Hopefully the results of this project as well as results from other reservoir studies will be used to help clarify the relationship between fluid pressure and earthquakes. These results would then be directed towards the goal of prevention of inadvertent triggering of earthquakes by fluid injection or reservoir filling.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0126. STRAIN STUDIES - CALIFORNIA, NEVADA, MONTANA

J.C. SAVAGE, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The project involves measurement of the deformation of the surface of the earth in the neighborhood of an active fault. Attention is concentrated on measuring fault creep by alignment arrays and creep meters, long-range deformation by geodimeter survey of triangulation networks centered on or near the fault, and surface tilt at several sites near the fault. The objectives of the research are to measure elastic strain accumulation (and hence earthquake risk) and to seek indications of premonitory deformation which might be useful for earthquake prediction.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0127. CRUSTAL STRAIN - CALIFORNIA, NEVADA, MONTANA, UTAH AND NEW MEXICO

J.C. SAVAGE, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

This project involves measurement of crustal deformation in the neighborhood of active faults using precise geodetic techniques (e.g., geodimeter surveys for horizontal deformation and level surveys for vertical movement). The objectives of the research are to measure slip and elastic strain accumulation along faults and to seek premonitory deformation

NORTHWESTERN OLYMPIC PENINSULA, WASHINGTON

P.D. SNAPELTY, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: Washington.

Project involves geologic mapping (scale 1:48,000) and stratigraphic, structural, and petrologic studies of the Cape Flattery area, northwestern Olympic Peninsula, Washington, and reconnaissance geologic studies of selected coastal areas in western Washington. These studies are designed to unravel the geologic history of the Tertiary eugeosyncline. The Cape Flattery area consists of two areas of Tertiary rocks which have undergone different styles of deformation. In the north half of area approximately 6,000 meters of deep-water marine sedimentary rocks of Eocene and Oligocene age overlie submarine basals of the lower to middle Eocene Crescent Formation. The marine strata dip gently to steeply northward, are broadly folded, and in places are cut by thrust faults. A major thrust fault at the base of the Crescent Formation separates this sequence from highly deformed deep-water marine sedimentary and volcanic rocks of Eocene age that form part of the core of the Olympic Peninsula. Faults with large displacement juxtapose formations of different ages as well as coeval rocks with different provenances; rocks with melange-like aspects are associated with the large thrust faults. The mineral resources potential, geologic hazards, and land-use problems will be evaluated and the studies will provide the onland geologic framework needed to interpret the geology of the adjacent continental margin and the Strait of Juan de Fuca.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0129. AUTOMATIC MICROEARTHQUAKE PROCESSING - CALIFORNIA

S.H. STEPHART, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The National Center for Earthquake Research systematically analyzes the earthquake recordings obtained from a network of more than 100 seismic telemetry stations located along the San Andreas Fault system in California. Both the systematic processing of these telemetry data, and the operation of a viable system for earthquake prediction or control, require detailed analysis of the seismic activity within a few hours, and perhaps minutes, of its occurrence. The goal of this project is to provide a system capable of rapid and detailed analysis of earthquakes occurring within the NCER seismic telemetry network in California.

At present two special-purpose digital computers are used to develop and implement real-time and off-line methods of earthquake data acquisition and processing. Real-time monitoring on a part-time basis of a 30 station subset of the larger San Andreas seismic telemetry network was carried out for six months in 1972. This experiment demonstrated the practical feasibility of long-term monitoring in real-time by a computer. A dedicated special-purpose computer system is used now to monitor all 97 vertical component seismometers within the NCER San Andreas seismic telemetry network. P phase onset times, amplitudes and other parameters are output to appropriate media within 1-2 minutes of the occurrence of an earthquake within the network. Epicenters and magnitudes are calculated off-line.

tion system. The two special-purpose computers presently in use by NCER will form the core of these data acquisition and analysis systems. Investigation into the design of these systems is now underway.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0130, SEISMIC SOURCE STUDIES - CALIFORNIA

W. THATCHER, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

Analysis and interpretation of geodetic measurements made along the San Andreas fault zone in California have provided considerable information on the modes of strain accumulation and release in this region. In particular, these studies have revealed that significant aseismic slip occurred on the fault beneath the seismic zone in the years following the 1906 San Francisco earthquake. In central California, along the area of steady surface creep, geodetic data are sufficient to uniquely determine the average slip rate below 15 km on the fault within relatively small uncertainties, the estimate being 4.0 plus or minus 0.7 cm/yr.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0131, TECTONIC HISTORY - NORTH PACIFIC CONTINENTAL MARGIN - ALASKA

R. PONHUENE, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

Currently drill data from Leg 18 of the GLOMAR CHALLENGER are being analyzed and prepared for publication as has been done with each past summer's field work. The anticipated objective of this project, to synthesize the regional tectonic scheme of the Gulf of Alaska continental margin, cannot be accomplished without additional geophysical field work. The objective is directed into two areas: (1) Earthquake hazard evaluation, including an understanding of the 1964 earthquake and an assessment of what is now considered the most likely site for a future great Alaskan earthquake, (2) develop an understanding of the regional tectonic framework so that the large, potentially petroliferous geologic structures of the continental shelf can be more accurately evaluated as to their resource potential.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0132, ACTIVE FAULTS AND GEOLOGIC HAZARDS, PE MUGU TO WILMINGTON, CALIFORNIA

H.C. WAGNER, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States in which project pertains: California.

Typical studies related to earthquake hazards in the southern California borderland, with geologic mapping and resource evaluation spinoff. Major objective of project is to reconstruct the depositional and structural setting of the area in order to determine the age and kinds of faulting along offshore faults as a means of evaluating their potential for earthquakes, tsunamis, landslides, or slump hazards as it relates to building construction or to Man's safety in areas of high population growth. The geologic mapping will fill gaps in knowledge of offshore parts of the southern California borderland and will provide a means of assessing surface and subsurface economic resources (e.g., sand and gravel, phosphate, manganese, oil and gas).

Surface fracture patterns along the San Andreas fault in California will be described and analyzed. Holocene faulting in north central Nevada will be studied with emphasis in 1974 on fault scarp morphology as a key to age and recurrence of movement on faults of this type.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0134, CALIFORNIA MEO NET

R.L. WESSON, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The primary purpose of this project is to gain understanding into the geologic and physical processes of elastic strain accumulation and release along the San Andreas fault system. This understanding will enable us to identify areas of high earthquake hazard and perhaps to predict moderate and large earthquakes.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0135, CENTRAL CALIFORNIA SEISMICITY STUDIES - CALIFORNIA

R.L. WESSON, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The goals of this project are: 1. To construct, through the collection, analysis and interpretation of seismic data from central California, models of the earthquake generating process enabling the prediction of earthquakes. 2. To identify and delineate active faults in central California, and to find methods of assessing their potential for producing a damaging earthquake, through the analysis and interpretation of seismicity data. 3. To provide timely, routine descriptions, catalogs and computer materials of the locations, depths, origin times and magnitudes of earthquakes in central California, for the use of this project, other Survey projects and outside agencies and researchers.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0136, APPLICATION OF DECISION THEORY IN STRUCTURAL DESIGN FOR RESISTANCE TO LOADINGS GENERATED BY EARTHQUAKE PHENOMENA

J.R. BENJAMIN, Stanford University, School of Engineering, Palo Alto, California 94305

This project will examine the development of a methodology incorporating the principles of statistical decision theory to assist the engineer in rationally designing structures for earthquake loading. The methodology will include the following aspects: phenomenology - development of appropriate probabilistic models for the phenomena based on the available data and postulated levels of design criteria; structural behavior - development of probabilistic models for the structural response to the phenomenal loadings and for relationships between response and postulated levels of structural damage; and, decision theory - selection of appropriate design criteria and corresponding design of the structure by optimization of the damage potential.

SUPPORTED BY U.S. Natl. Science Foundation

3.0137, APPLICATION OF PROBABILITY, STATISTICS AND DECISION THEORY IN SOIL ENGINEERING

J. H. H. Stanford University, School of Engineering, Palo

3 0138.

A specific objective is to study the use of 'partial safety factors' for systems that can fail in any one of several modes. Two examples will be considered (1) the design of an earth retaining structure like an anchored bulkhead, and (2) design of a compacted earth-fill dike in a seismic region. The values of the partial safety factors should reflect the uncertainties in loading, soil properties and in-situ soil stresses, as well as a consideration of the penalty of failure for different failure mechanisms

SUPPORTED BY U.S. Natl. Science Foundation

3.0138. STUDY OF MECHANISM OF ACCUMULATION AND RELEASE OF TECTONIC STRESS IN CENTRAL CALIFORNIA

4. NUR, Stanford University, School of Earth Sciences, Palo Alto, California 94305

Our ability to completely understand earthquakes rests on a fundamental problem: what is the mechanism of stress accumulation and release and its spatial distribution on earthquake faults? In the present research it is proposed to examine several aspects pertinent to the San Andreas fault system in central California: seismicity and source mechanism studies, the distribution of fault creep and its relation to tectonic stress; and theoretical studies of the relation between surface slip and deformation and stress changes on faults.

SUPPORTED BY U.S. Natl. Science Foundation

3.0139. CALTECH SEISMIC NETWORK AND SAN FERNANDO EARTHQUAKE STUDIES

C.R. ALLEN, Calif. Inst. of Technology, Graduate School, Pasadena, California 91109

Support of California Institute of Technology seismic network and San Fernando earthquake studies will be continued under the grant. Fifteen publications by staff and students have already resulted from the first year's efforts, and several more are nearing completion. Proposed continuing and new studies include (1) continuing studies of aftershock locations and tectonic implications, (2) inversion studies of the static displacement field, (3) source studies of San Fernando aftershocks using broad-band recording on portable seismic units and (4) support of telemetry expenses for the California Institute of Technology southern California seismographic network.

SUPPORTED BY U.S. Natl. Science Foundation

3.0140. EARTHQUAKES AND INSURANCE - ERA CONFERENCE 2-3 APRIL 1973

J.C. FULTON, Calif. Inst. of Technology, Center for Res. Prev. Disaster, Pasadena, California 91109

The annual conference of the Earthquake Research Affiliates, California Institute of Technology, was held on 2-3 April 1973 on the campus of the California Institute of Technology. Some of the papers presented at the conference dealt

3.0141. MODAL COUPLING AND EARTHQUAKE RESPONSE OF TALL BUILDINGS

J.B. HOERNER, Calif. Inst. of Technology, Earthquake Engin. Res. Lab., Pasadena, California 91109

Abstract: The major dynamic features of tall buildings are examined with a shear beam model. The usual one-dimensional model is extended to three dimensions to include modes with translational and rotational components. A class of linear response models for tall buildings is presented having three sets of mutually orthogonal coupled modes. The amount of modal coupling is related to the eccentricities and frequency differences. A perturbation scheme is developed for buildings almost in this class. Rotational components of earthquake response in buildings are related to modal coupling.

Pub. May 71: 163P., NBS No. 19B-207 6.35; PC \$3.00 MF \$0.95.

SUPPORTED BY California Inst. of Technology - Pasadena

3.0142. EVALUATION OF THE INCREMENTAL SEISMIC RISK DUE TO RESERVOIR FILLING

G.W. HOUSNER, Calif. Inst. of Technology, School of Engineering, Pasadena, California 91109

The Ad Hoc Committee on Earthquake Effects on Dams will (1) investigate the problems posed by earthquakes concerning the safety of large concrete, earth and rockfill dams, and define the most important problems in need of intensive research, (2) investigate the influence of the reservoirs created by large dams on seismic activity in the local environment, and (3) recommend the procedures necessary to define the investigations and design methods that will mitigate earthquake effects upon them. This ad hoc committee was formed in March 1973 by the United States Committee on Large Dams (USCLD), the U.S. branch of the International Commission on Large Dams.

SUPPORTED BY U.S. Natl. Science Foundation

3.0143. THREE-YEAR OPERATION OF THE UNIVERSITIES COUNCIL FOR EARTHQUAKE ENGINEERING RESEARCH

W.D. IVAN, Calif. Inst. of Technology, Graduate School, Pasadena, California 91109

The need for a sound basis on which to make decisions on how civil structure should be designed to reduce earthquake risk has led many academic researchers to enter the field of Earthquake Engineering in recent years. Having recognized the scope of research needs relative to the resources available to support these needs, the several universities active in the field formed the Universities Council for Earthquake Engineering Research (UCFER) in 1966. UCFER acts as a focus for University researchers to disseminate and coordinate their activities. The objective of this grant is to insure dissemination of earthquake engineering research. This award will supply the financial support necessary for conferences, report production, mailings to members, etc. Two con-

Abstract: The report describes the dynamic properties of a twenty-two story office building subjected to simulated earthquake vibration.

Pub. Feb. 71: 99p., NTIS No. PB-205 161: PC \$3.00 MF \$0.95.

SUPPORTED BY California Inst. of Technology - Pasadena

3.0145. STRAINS AND TILTS ASSOCIATED WITH THE SAN FERNANDO EARTHQUAKE

P. JUNGELS, Calif. Inst. of Technology, Seismological Laboratory, Pasadena, California 91109

Abstract: The San Fernando Earthquake of February 9, 1971, was well recorded on the quartz seismometer and mercury tiltmeters at Caltech's Isabel station, 147 km north of the epicenter. Strains were recorded also on a laser strain meter at UCSD and 2 strainmeters near the Nevada test site. (respectively 210 and 380 km from the epicenter) The permanent offsets are consistent with the strain release that is inferred from the fault plane solution and surface breakage.

Pub. 1971: 4p., NTIS No. AD-727 403: Reprint.

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0146. PUGET SOUND, WASHINGTON, EARTHQUAKE AND THE MANTLE STRUCTURE BENEATH THE NORTHWESTERN UNITED STATES

D. MCKENZIE, Calif. Inst. of Technology, Seismological Laboratory, Pasadena, California 91109

Abstract: A detailed study of the travel time anomalies of the Seattle earthquake supports the existence of a high-velocity slab dipping at 50 degrees E. beneath southwestern Canada and the northwestern United States.

Pub. Jan. 71: 6p., NTIS No. AD-738 409: Reprint.

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0147. A STUDY OF STRONG EARTHQUAKE GROUND MOTION USING AN ARRAY OF ACCELEROGRAPHS - CALIFORNIA

M.D. TRIFUNAC, Calif. Inst. of Technology, School of Engineering, Pasadena, California 91109

A closely-spaced alignment of strong-motion accelerometers will be installed along the San Jacinto-Imperial Fault system of Southern California. The historical rate of magnitude 6 and greater earthquakes on this fault system is that they have occurred at the average rate of one every seven years since 1890; the interval between successive major events has never been more than 14 years. It is anticipated that such an event will occur in the next 3-10 years. It is expected that detailed near-source acceleration records of a major earthquake, whose associated rupture should traverse 3 or more of the instrument localities, will be obtained within the next decade.

This information will considerably expand our knowledge concerning (1) the maximum accelerations associated with moderate to large vertical strike-slip earthquakes in Southern California, (2) the generation of high frequency radiation and estimates of total radiated energy, (3) the propagation velocity of the associated dislocation, (4) the detailed mechanism of the earthquake (smoothly propagating dislocation or a multiple complex event), (5) the distribution of larger aftershocks immediately following the earthquake, and (6) decay of high frequency amplitudes (of both engineering and scientific interest) with distance from the rupture zone.

J.H. WOOD, Calif. Inst. of Technology, Earthquake Engin. Res. Lab., Pasadena, California 91109

Abstract: A study has been made of the earthquake response of the nine-story steel frame Building 180, located at the C.I.T. Jet Propulsion Laboratory, Pasadena, during the San Fernando earthquake of February 9, 1971, which was motivated by the likelihood that an earthquake similar to the February 9, 1971, shock could occur close to the JPL grounds with consequent very strong ground shaking. The analysis throws light on the actual dynamical properties of the building during the earthquake, and demonstrates that it is possible to make accurate calculations of building motions during earthquakes when the ground motion is specified. Periods of the lower modes from pre- and post-earthquake tests are compared with those during the earthquake, and calculations are made of damping ratios, roof accelerations, maximum stresses, and Fourier spectra.

Pub. Oct. 72: 154p., NTIS No. PB-215 823/6: PC \$6.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

3.0149. THE SEISMIC SAFETY STUDY FOR THE GENERAL PLAN

D. ARMSTRONG, Tri Cities Seismic Safe. Study, Richmond, California 94806

The Seismic Safety Study for the General Plan is one of three reports issued by the Tri-Cities Study. Pursuant to State Law enacted in 1972, all California cities must include a Seismic Safety Element in their General Plan. This Study is the first major Seismic Safety Study for the General Plan produced in the State and will be distributed as a model to all California cities by the California Council on Intergovernmental Relations. The essential parts of the Seismic Study are: 1) Detailed Findings of the earthquake situation in the Tri-Cities Areas, including geologic and structural factors, present uses and disaster implications, 2) Policies to guide future development and regulate existing development, and 3) Specific recommendations for action by the cities.

Pub. Sept. 73: 199p., Calif. Council on Intergovernmental Relations, Sacramento, Calif. 95816, and NTIS.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

3.0150. MEETING THE EARTHQUAKE CHALLENGE - FINAL REPORT TO THE LEGISLATURE STATE OF CALIFORNIA BY THE JOINT COMMITTEE ON SEISMIC SAFETY

K.P. STEINBRUGGE, State Legislature, Sacramento, California 95814

This document is the result of four years of intensive study by the Joint Committee on Seismic Safety, California Legislature, and over 70 technical advisors.

Its recommendations are presented in two sections: first, a comprehensive approach to seismic safety including high-priority legislative proposals; and second, five detailed advisory group reports. These recommendations are supported by a third section of supplementary materials.

Pub. Jan. 74: 223p., No copy info. available.

3.0152.

The primary objective of the study of the San Fernando earthquake, February 9, 1971, by the Special Subcommittee of the Joint Committee on Seismic Safety is to examine and evaluate the effects of the earthquake and to learn from that earthquake what public policies are needed to minimize injury, loss of life, damage to structures, and disruption of the economy from future potentially damaging earthquakes, not only in the San Fernando area but also in other parts of California.

The Special Subcommittee has been assisted by consultants who are especially qualified in their respective fields of study regarding the earthquake: geologic and seismic factors; dams and soils; structural engineering related to buildings; utilities, communications and transportation facilities; disaster preparedness; land use planning; and government organization and performance. The report prepared on each topic is based on careful analysis and evaluation, in terms of the objectives of the study, of information on the effects the San Fernando earthquake. Some of the information was gathered first hand and some was obtained by other organizations that have studied the earthquake.

Pub. July 72: 132p., No copy info. available.

Abstract provided by FDAA.

SUPPORTED BY California State Government - Sacramento

3.0152, ELASTOMERIC ENERGY ABSORBER

L.F. NORDLIN, State Materials & Res. Dept., Sacramento, California

Abstract: The report covers testing performed on a proposed elastomeric energy absorbing and restraining unit designed to restrict movement at the hinge openings of reinforced concrete bridge spans when subjected to earthquake forces. Minor modifications were made for each of five tests conducted on a thick walled neoprene tubing contained in extra heavy steel pipe. Load-deflection tests of the restrained neoprene determined the final amount of movement for the forces involved. The results are reported.

Pub. Nov. 71: 21p., NTIS No. PB-207 838; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Transportation - FHWA

3.0153, EARTH STRUCTURE AND FAULT TECTONICS AS RELATED TO EARTHQUAKE PREDICTION - CALIFORNIA

J. BERGER, Univ. of California, Graduate School, San Diego, California 92038

It is proposed to study the long term pattern of strain accumulation, tilt and vertical displacement in southern California for the purpose of relating earth structure and fault tectonics to the occurrence of earthquakes. The temporal and spatial characteristics of the ground motion will be investigated utilizing two established geophysical observatories containing a collection of wide-band instrumentation in conjunction with several movable tiltmeters. Special emphasis will be placed on measurements of earth strain utilizing the 3 component surface laser strain meter now in operation which has established a new low level of instrumental noise, long term stability and freedom from spurious 'strain episodes' and 'steps.' The wide band nature of this instrumentation will facilitate the investigation of the ground motion spectrum

California and their relation to fault tectonics will be studied by examining the effects of ocean tidal loading on the observed earth tides.

SUPPORTED BY U.S. Natl. Science Foundation

3.0154, ELEMENTS OF DYNAMIC-INELASTIC DESIGN CODE

J.A. BLUME, John A. Blume & Associates, San Francisco, California

The need for a dynamic-inelastic design code that provides greater utilization of available knowledge than the current earthquake codes is discussed followed by the philosophy of such a code including the requirement for reasonable simplicity and workability. Elements of the code are presented as a supplementary section to existing static-elastic requirements. Two levels of earthquake intensity are specified. The dynamic-inelastic provisions are based upon kinetic energy reconciliation with energy stored, converted to heat, and used to do work in the inelastic range as in the reserve energy technique.

Pub. 1972: 10p., NTIS No. CONF-7301 (20) PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Atomic Energy Commission

3.0155, MEASUREMENT OF MOVEMENT ON THE SAN ANDREAS FAULT

R.D. NASON, U.S. Dept. of Commerce, Earthquake Mechanism Lab., San Francisco, California

Abstract: The San Andreas fault is a major earthquake center in California. Its geologic history indicates continuing displacement at about 1.2cm/yr over the past 25 million years which is less than the estimates in current theories of global plate tectonics. Current movement on the fault is by fault displacements in earthquakes and by gradual fault creep slippage not directly related to earthquakes. Fault slippage in the historic period 1848 to 1968 has been equivalent to about 2.5cm/yr average fault displacement.

Pub. 1970: 246-254p., NTIS No. COM-71 00222; Reprint

SUPPORTED BY U.S. Dept. of Commerce - NOAA

3.0156, ACTIVE DISPLACEMENT ON THE CALAVERAS FAULT ZONE AT HOLLISTER, CALIFORNIA

T.H. ROGERS, U.S. Dept. of Commerce, Earthquake Mechanism Lab., San Francisco, California

Abstract: The Calaveras fault zone, which is a major branch of the San Andreas fault system in northern California, passes through the City of Hollister 160 km (100 miles) southeast of San Francisco. Active fault displacement (fault creep slippage) has occurred in and near Hollister along a fault trace within the Calaveras fault zone. Various man-made structures crossing the fault trace have been deformed and gradually offset in a right-lateral sense. The amount of offset varies directly with the age of the structure. Rates of active fault displacement vary with time and position along the Calaveras and San Andreas fault zones in the Hollister area. The pattern of this variation suggests that active displacement on the San Andreas fault zone may be transferring northeastward to the Calaveras fault zone.

Pub. Apr. 71: 399-416p., NTIS Order No. COM-71 0081 Reprint.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

MAJOR DISASTER TYPES

3.0163

Objectives: The objective of this project is to determine where and how frequently destructive earthquakes (M equals 5) are likely to occur in the Santa Barbara Channel region. Thus we seek to provide answers to the following more specific questions: 1) Where are the major faults? 2) What have been their geological and historical records of movement? 3) Is strain accumulating across fault zones? 4) Is creep occurring along faults? 5) Where have historic earthquakes occurred here and what have been their effects? 6) Where are earthquakes occurring presently?

How information will be applied: Our information on the seismicity, fault locations, and seismic hazards will be of use chiefly to public officials involved in land use planning and public safety. Already our preliminary results on these subjects have been requested formally and informally by local city, county, and university land use planners and safety officials, state and federal geological agencies, individual citizens, local educational institutions, and private industries. In addition, our geodetic studies may result in an earthquake warning system.

Accomplishments during the past twelve months: 1. Detection of 4 - 1.3 cm/year vertical movement in the Santa Barbara area. 2. Detection of past earthquake vertical movement following the 1971 San Fernando Earthquake. 3. Analysis of U.S.C. & GS precision level data along the California coastline. 4. Installation of tilt meters along significant faults in the Transverse Range region. 5) Study of effects of 1925 S.B. Earthquake. 6. Fault map of Santa Barbara Channel region. 7. Santa Barbara Earthquake history since 1800. 8. Design and construction of precision tide gage.

For additional information pertaining to this project contact Dr. George G. Shor, Jr., Scripps Institution of Oceanography, La Jolla, California 92037.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3.0158, FHA STUDY OF SEISMIC DESIGN CRITERIA FOR HIGH-RISE BUILDINGS

R. W. CLOUGH, T.Y. Lin & Associates, Van Nuys, California

Abstract: The report describes the results of a program of study and research into the earthquake behavior of high-rise buildings. The techniques and standards for the earthquake resistant design of traditional types of buildings are reviewed briefly. A digital computer investigation into the response of various high-rise structural systems was undertaken to extend the understanding of their response to seismic excitation, thus enabling the development of new design criteria which will maintain adequate factors of safety in new types of constructions. An investigation into the structural performance of three buildings in Anchorage during the March 27, 1964 earthquake was carried out. Finally, recommendations for seismic design criteria are specified.

Pub. Aug 66: 368p., NTIS No. PB-202 960: PC \$6.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

soil conditions. Strong motion sites are to be geologically evaluated such that data recorded can be fully and reasonably interpreted.

Progress: The research plan above has produced results which are being readied for evaluation by seismic design consultants. These results are in the form of highly detailed maps and supporting charts, graphs, tables.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3.0160, THE SEISMIC RISK MAP OF THE UNITED STATES - DEVELOPMENT, USE, AND PLANS FOR FUTURE REFINEMENT

S.T. ALGERMISSEN, U.S. Dept. of Commerce, Earth Sciences Laboratories, Boulder, Colorado 80302

Abstract: The risk map currently used by the Uniform Building Code is based primarily on an analysis of seismic intensities recorded during historical time, epicentral locations of damaging earthquakes, and their relationships to important fault systems and tectonic elements. Recommendations are made for short term and long term improvements. The author concludes with the statement that there is real need for further study of the earthquake losses likely to occur in the United States in the next 50 to 100 years.

Pub. 1972: 7p., NTIS No. COM-73-10290: Reprint.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3.0161, A STUDY OF EARTHQUAKE LOSSES IN THE SAN FRANCISCO BAY AREA - DATA AND ANALYSIS

UNKNOWN, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302

The purpose of the Report is to provide essential data for effective pre-disaster planning for major damaging earthquakes that might affect the San Francisco Metropolitan area.

The study postulates potential maximum credible earthquakes which could occur in the area, and examines the probable effects of such a disaster on the people and critical facilities and life support systems (homes, hospitals, schools and major transportation, communications and public utilities systems).

Pub. 1972: 220p., No copy info. available.

Abstract provided by FIDAA.

SUPPORTED BY U.S. Executive Office - O.E.P.

3.0162, A STUDY OF EARTHQUAKE LOSSES IN THE LOS ANGELES, CALIFORNIA AREA

UNKNOWN, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302

The purpose of the Report is to provide essential data for effective pre-disaster planning for major damaging earthquakes that might affect the Los Angeles Metropolitan area.

The study postulates potential maximum credible earthquakes which could occur in the area, and examines the probable effects of such a disaster on the people and critical facilities and life support systems (homes, hospitals, schools and major

3.0164.

A seismic risk map was developed for Utah and Arizona. The map depicts (as contours) the maximum horizontal ground acceleration in a 50-year period. The accelerations mapped have a 10 percent probability of exceedance.

A very accurate hypocenter was determined for the destructive December 23, 1972 Managua, Nicaragua earthquake using an accelerograph record recorded during the earthquake and observed intensities. This accurate location was used to compute station corrections for seismograph stations throughout the world and to recompute the location of the larger earthquakes in the Managua area during the past 50 years.

The long range plans of the project include: (1) Development of theory, analysis of seismic data, and the evaluation of parameters for the preparation of seismic risk maps and associated tables; (2) Evaluation of hazards such as soil liquefaction and land slides, and (3) Investigation of earthquake aftershock activity and intensity distribution associated with damaging or otherwise significant earthquakes.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0164. SEISMIC RISK CORPS OF ENGINEERS - CONTIGUOUS UNITED STATES

H.H. HAYS, U.S. Dept. of the Interior, Geological Survey, Boulder, Colorado 80302

State of the art information required for developing design earthquake response spectra is being compiled in a manual-like format. The objective is to provide by July 1974 to the U.S. Army Corps of Engineers, Construction Engineering Research Laboratory, a rational methodology for estimating the important characteristics of the earthquake ground motion load during construction, design, and evaluation of important military facilities located throughout the United States. The methodology will describe how to perform the following analyses: 1) determination of seismicity parameters, 2) estimation of seismic attenuation functions, 3) estimation of maximum intensity of shaking, 4) estimation of ground motion response spectra, and 5) estimation of local site amplification effects. The manual will have wide application to many earthquake risk analysis projects.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0165. VA. SEISMICITY - 32 STATES AND PUERTO RICO

B.V. MICK, F. U.S. Dept. of the Interior, Geological Survey, Boulder, Colorado 80302

Provide VA with guidance and consultation concerning adequacy of seismic evaluations submitted by contractors concerning seismicity characteristics in the vicinity of VA hospitals. These results will enable design and structural engineers to build new and reinforce old structures to withstand effects of most likely earthquakes in the area.

This contract work is a part of our mission to evaluate seismic risk. It also makes seismic history data available to the USGS at no additional cost.

There are over 70 hospitals involved in this study in seismic zones 2 and 3.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

Provide data on possible control of seismicity by man and on localized seismic characteristics.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0167. SEISMICITY AND EARTH STRUCTURE

J. FAGGART, U.S. Dept. of the Interior, Geological Survey, Boulder, Colorado 80302

States to which project pertains: Worldwide with emphasis on continental states.

Regional P-wave travel times, source region velocity models and relative location techniques are developed and evaluated for application toward improvement of the location accuracy of earthquake hypocenters. A laterally variable velocity model of the crust and upper mantle under the continental United States will be evaluated in 1974.

A major revision of the sequence of hypocenter computational programs used by the National Earthquake Information Service will begin in 1974. The programs will be rewritten to use on the DEC 1070 computer at the Denver Federal Center and will incorporate new criteria for association of data from discrete earthquakes. Focal mechanisms of the major or important earthquakes will be published.

The tectonic framework of seismic regions will be analyzed on a continuing basis through investigation of aftershock locations, magnitudes, origin times, and focal mechanisms. Determination of hypocenters with fixed network, master event and joint location techniques will improve the relative accuracy of the computations.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0168. SOUTH CAROLINA SEISMICITY PROGRAM

A.C. FARR, U.S. Dept. of the Interior, Geological Survey, Boulder, Colorado 80302

States to which project pertains: South Carolina

Because of the occurrence of the great 1886 Charleston earthquake, the seismic hazard for the state is potentially great, especially for existing facilities such as the Savannah River plant and the construction of new nuclear reactors. Any estimate of that hazard must be based on sound quantitative data which heretofore have not been available. Understanding why this area is seismically active, and comparing it with other seismic areas in the context and broader scope of the theories of plate tectonics, should aid in the greater clarification of the seismicity of the entire East Coast.

The objectives of the program are: 1. Provide essential high quality raw seismic data from earthquakes in South Carolina. 2. Compute accurate estimates of event and source parameters: i.e., hypocenter parameters, fault plane solutions (for individual & composite), spectral analyses (stress drop and other source parameters). 3. Provide a catalog of events and source parameters that will be used in further evaluation of seismic hazard: maps, depth sections, statistics. 4. Conduct special seismological studies as they are indicated, such as network calibration with explosions and refinement of hypocenter parameters via ray-tracing. 5. Respond with rapid estimates of event parameters if a large event (M about 4 1/2) occurs within South Carolina during the duration of the

principal objective is to provide a geologic base for a continuing study of the environmental geology of the region. This is part of a larger project to study the central Rio Grande trough in areas of major population centers. Emphasis is being placed on geologic studies of the Cenozoic fill within the trough where recent faulting, slope stability, ground and surface water, and waste disposal problems require geologic background for potential land use.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0170, GEOLOGY OF THE RAPID CITY AREA, SOUTH DAKOTA

J.M. CATTERMOLE, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: South Dakota.

The Rapid City project is a general geology and engineering geology study of a rapidly growing urban area. Three quadrangles, Rapid City West, Rapid City East, and Rapid City NW, have been mapped geologically at a scale of 1:24,000. The maps of the Rapid City West and Rapid City East have been published in the Geologic Quadrangle Map Series in full color with a columnar section and text; the map of the Rapid City NW quadrangle was scheduled to be printed in 1973 and should be released early in 1974.

The final product of the project is a two part Bulletin covering the entire urban area of Rapid City: the first part will describe the geology, structure and stratigraphy of the three quadrangles; the second part will detail foundation conditions, expansive soils, construction materials, landslides, and physical characteristics of each formation and the pertinent effects related to planning engineering projects.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0171, EARTH AND ROCKFILL DAM DESIGN PRACTICES

L.M. CHRISTIANSEN, U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado 80225

A continuing program to improve Earth Dam Design practices is being pursued through evaluation of construction performance, structure performance measurements, operation and maintenance experience and review of literature. Collected data is evaluated from time to time and compared to previously established design practices. Modifications are then introduced in the design practices, data collection procedures, measuring apparatus, or methods of analysis and evaluation to reflect the effect of accumulated experience.

Current operations include: Improved piezometer design to register negative pressures and reduce failure in installations. Statistical appraisal of construction variation in compaction of materials and establishment of conditions for testing. Development of standards for earthquake hazard evaluation. Improvements in stability analysis.

SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

3.0172, GREATER ANCHORAGE AREA BOROUGH, ALASKA

E. DOBROVOLNY, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Alaska.

In consequence of the geologic effects of the Alaska

final stages of compilation for the Greater Anchorage Area Borough, which encompasses about 1,750 square miles. Study of Quaternary deposits is emphasized because most land-use development is concentrated on them. Special-purpose maps, such as slope stability, construction materials, and foundation and excavation conditions are being prepared from the general geologic map for use by planners and developers. The geologic work is closely coordinated with hydrologic investigations being conducted by the USGS Water Resources Division. Data developed by these combined studies are adequate to establish patterns of geologic and hydrologic relationships applicable to regional planning. For specific site development, however, more detailed and intensive investigation is required.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0173, EARTHQUAKES AND ACTIVE FAULTS

J.S. DODD, U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado 80225

The primary objective of this program is to obtain knowledge of the crustal strain at the surface and at depth that develops along an active fault. Such information will direct our efforts toward the critical and equally important matter of controlling or avoiding disastrous damage to hydro projects by earthquakes.

To obtain fundamental knowledge of earth strain and associated earthquake behavior a 5-year cooperative program with United States Geological Survey is in its third year. The program consists of recording low-magnitude earthquakes and measuring earth displacements and strains associated with three very active geologic faults - the San Andreas, the Sargent, and the Calaveras - in the Hollister Valley of Central California.

SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

3.0174, NEW MADRID EARTHQUAKE - ARKANSAS, ILLINOIS, KENTUCKY, MISSISSIPPI, MISSOURI AND TENNESSEE

M.F. KANE, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

The principal objective of the project is to attempt to establish the location of main strand or zone of the New Madrid fault system through whatever effect it may have on the magnetic basement rocks, and its subsequent expression in the aeromagnetic field. Complementary studies will be undertaken in gravity by compiling and analyzing existing data.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0175, ENGINEERING GEOLOGY RECONNAISSANCE STUDIES OF COASTAL COMMUNITIES, ALASKA

R.W. LEMKE, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Alaska.

Reconnaissance engineering geology studies, directed principally toward assessing potential earthquake and other geologic hazards, have been completed in the following Alaska coastal towns: Skagway, Haines, Sitka, Ketchikan, Metlakatla, Petersburg, Wrangell, Yakutat, Hoonah, Nome, Bethel, Dillingham, Naknek-King Salmon, Unalakleet, Kotzebue, and Barrow. It is concluded that most parts of these towns are built on more stable geologic materials than those

liquefaction, and subsidence due to soil compaction. In addition, harbor areas and other low-lying parts of some towns may be damaged by vertical changes in the land, by seismic sea waves, and by other abnormal waves produced locally by land tilting or by submarine landsliding.

Reports on the southeastern Alaska region, Haines, and Skagway have been released in open file, and reports are in various stages of preparation for the other communities. As of early 1973, this large project has been restructured, and report preparation responsibilities for Sitka, Metlakatla, Hoonah, Yakutat, Bethel, Naknek-King Salmon, and Unalakleet assigned to project 9550-00948.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0176, DENVER METROPOLITAN AREA, COLORADO
R.M. LINDVALL, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Colorado.

The project objective is to prepare detailed general-purpose geologic maps of eight quadrangles covering the major part of the Denver metropolitan area. These maps, at a scale of 1:24,000, are designed to provide basic information on the geologic factors pertinent to maximum utilization of land in a rapidly expanding area of urban development. Information to be provided concerns the engineering properties of the surficial and bedrock units, location of potential hazards such as landslides, areas subject to flooding, areas subject to possible earthquake damage, areas of poor foundation conditions, and the location and extent of sand and gravel deposits necessary for construction aggregate materials.

The geologic maps, each including a brief descriptive text, are to be released first in open files and subsequently published in the Geologic Quadrangle Map Series. The geologic map of the Parker quadrangle was published in 1972 as the first sheet in a special Folio of the Parker quadrangle. Thirteen additional single-concept maps of the quadrangle have been or will be published in the near future to complete the Folio. The enthusiastic acceptance of the Parker Folio by planning commissions and public officials have prompted plans to issue some similar interpretive maps for the adjoining Highlands Ranch quadrangle.

A comprehensive geologic report covering all eight quadrangles is planned for the Bulletin series.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0177, V. A. HOSPITAL SITE EVALUATIONS
T.C. NICHOLS, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Various states in the U.S. and Puerto Rico

Conduct reviews on the completeness of geologic content and on specific geological aspects of seismic evaluation reports on Veterans Administration Hospital sites as submitted to the V. A. by consulting firms.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0178, SNAKE RIVER PLAIN, PART A - REGIONAL TECTONICS - IDAHO

S.S. ORIEL, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

The tectonic framework of the Snake River Plain and adjoining ranges is being analyzed to provide a basis for realistic appraisals of seismic and associated hazards along the Idaho segment of the Intermontane seismic belt. The project

Regional geologic and geophysical data are being analyzed to shed light on the internal part of a folded thrust sheet and the geodynamics of continental plateaus of the West. SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0179, EASTERN SNAKE RIVER PLAIN INVESTIGATIONS - IDAHO

S.S. ORIEL, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

Principal objective is to coordinate Survey investigations and encourage other geologic studies of the Snake River Plain for the derivation of land resource information for planners and decision makers.

Aims are: To minimize earthquake, slope, and volcanic hazards in this northern part of the Wasatch seismic belt; to develop a framework for use in environmental policy development of these areas; to provide data for planning and development of this balanced agricultural and urban region; and growing part of Idaho. To develop a framework for aquifer and waste-disposal management where increasing wastes threaten a major aquifer and the mineral resource and geothermal potential of the region.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0180, TECTONIC ANALYSIS OF FIVE ZONES IN NEVADA, IN SUPPORT OF EARTHQUAKE CONTROL EXPERIMENT - NEVADA, UTAH

P.P. ORKHO, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

One of the program goals of the Great Basin Earthquake Hazards Reduction Program is to determine the probability of earthquake control on real faults. The Nevada Project is an integral part of an earthquake modification experiment, and will therefore be closely associated with associated studies of seismicity, strain, and hydrology.

The sparsely populated Great Basin of Nevada and parts of California and Utah contains many seismic areas where an earthquake modification experiment safely conducted on faults similar to the San Andreas and other faults of western California. Historic large (magnitude 6 or greater) earthquakes have occurred in a belt from Owens Valley north-northeastward through Mineral and Chinle, Nevada. This belt follows and crosses known strike-slip zones such as the Death Valley fault, the Walker Lane. Surface breakage of this belt has had a strong compressional motion. Other parts of the Great Basin, though the site of large earthquakes are currently active and contain faults of known Pleistocene and recent movement.

The bifold purpose of the Nevada Tectonics Project is to provide the appropriate geologic and tectonic data to assist in the selection of a site in the Nevada earthquake modification experiment, and (2) to develop a comprehensive understanding of the tectonic framework of the Nevada region, with emphasis on tectonism. An understanding of the tectonic framework is needed to provide a scientific basis for earthquake hazard evaluation and for evaluation of sites for an earthquake modification experiment.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

D. SCHLEICHER, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

This project is part of a study of the eastern Snake River Plain, whose aim is to gather geologic data needed for land-use planning. I plan to prepare one or more maps at scales 1:250,000 and larger showing geologic units and structures that represent hazards or resources. In the core of the Beaverhead Mountains, the main emphasis will be on working out the stratigraphy as to decipher the structures that can be extrapolated beneath the volcanic rocks of the Snake Plain. On the surrounding flats and the flanks of the range, the plan is to map the young volcanic rocks and sediments, to identify and date young faults and volcanic eruptions, and to note other potential hazards.

The study area is bisected by the southern end of the Beaverhead Mountains, which are cored by Mississippian and Pennsylvanian carbonates and quartzites, whose stratigraphy remains poorly known. The rocks are slightly to severely deformed, with local complex folding and thrusting. The range is separated from the surrounding flats by range-front faults; the faults are probably younger on the west side of the range than on the east where they are mantled by ash-flow tuffs intercalated with tuffaceous, partly cemented fan gravels that are probably a few million years old. The absence of young faults accords with the absence of epicenters reported here during this century. The area has geothermal potential, reflected by Lido Hot Springs and the springs feeding Warm Creek, and suggested by a hitherto-unrecognized intrusive plug at the south end of the Beaverheads. Extensive alluvial aprons may yield water, and areas of silty soil (reworked loess?) may prove arable.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0182, SNAKE RIVER BASIN, PART F - SOUTHERN PART, NORTHWEST MARGIN - IDAHO

B. SKIPP, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

The project involves the mapping, to be compiled at 1:250,000, of all or parts of thirty 7½ quadrangles, situated along the southwestern part of the northwest flank of the eastern Snake River plain. The chief objectives are: (1) the understanding of the little known Late Paleozoic rock sequences through stratigraphic and paleontologic studies; (2) the determination of the complex structures which involve the Paleozoic sequences; (3) the determination of the structural relationships between the Paleozoic rocks and the Holocene lava flows along the north edge of the Snake River Plain; (4) the providing of a geologic framework for environmental studies in the region; (5) the study of recent faulting and landslide distribution possibly related to earthquake activity; and (6) the supplying of a well-mapped area adjacent to Snake Plain which will aid in interpretation of gravity and aeromagnetic surveys across the plain.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0183, EFFECTS OF EARTHQUAKES ON SOIL PERFORMANCE

D.A. TIEDEMANN, U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado 80225

The soil foundation is an important consideration in the design of structures resistant to earthquake damage. The investiga-

Laboratory tests on possible problem soils are conducted in special laboratory equipment involving a cell for applying triaxial conditions, but with an additional pulsating load system for simulating earthquake activity. The testing has been extended from sands to a program on silt which is investigating effects of placement density and moisture on the dynamic behavior of the silt. Tests with new resonant column equipment are being conducted on soil specimens for correlation with the above-mentioned tests on silt.

New laboratory equipment is being designed, constructed, and assembled to accommodate larger specimens for determination of dynamic properties. For this testing a variable vibratory input can be programmed. Also field vibratory testing methods are being improved. These developments will lead to better test data for improved design of earth and earth-supported structures.

SUPPORTED BY U.S. Dept. of Interior - Bu. Reclamation

3.0184, HAMILTON 2 DEGREE

J.D. WELLS, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Montana and Idaho.

Prepare a geologic map of the Hamilton 2-degree sheet at 1:250,000 scale, integrating the past, current, and future pertinent mapping done by industry, universities, and State and Federal agencies, and incorporating geologic, geochemical, isotopic, and geophysical data as a basis for evaluation of land use and mineral potential. Special purpose interpretative maps and reports will be prepared of appropriate areas where potential hazards such as landslides, unstable foundation material, faulting, earthquakes, and flooding are present. An evaluation of known and potential mineral resources of base and precious metals and fluorite along the margins of the Idaho Batholith and stratabound copper in the Beltan strata will be made. These data will contribute to the general body of geologic knowledge of the northern part of the Idaho Batholith and contribute in developing the regional structural, stratigraphic, magmatic, metamorphic, and erosional patterns. They will further provide a proper basis for land use planning for the diverse interests in this area of urban development in an outstanding recreational area.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0185, SNAKE RIVER PLAIN, PART B - VOLCANIC ROCKS - IDAHO

P.L. WILLIAMS, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

The purpose of the project is to geologically map, at scales of 1:250,000 and larger, the volcanic rocks of the eastern Snake River Plain and its margins. Major scientific objectives are to delineate the late Cenozoic volcanic and tectonic history in detail, to locate eruptive centers for basalt flows and for rhyolite ash-flow tuffs in relation to major structures, Quaternary faults, and geothermal areas, and to determine petrogenesis of the rocks. From the basic geologic data, derivative maps will be prepared showing potential earthquake and volcanic hazards, geothermal energy potential, construction materials and mineral resources, environmental aspects of trace element distribution, aquifers and liquid waste disposal sites, potential recreation areas, and other topics needed for land-use planning.

be taken to minimize loss in future earthquakes. It is based on a careful review of events during and following the disaster that befell south central Alaska in March 1964. Emphasis is on lessons to be learned from the Alaskan experience that can be applied to any region where strong earthquakes may be expected.

The Committee's recommendations are given in the first chapter. The second chapter presents the more detailed conclusions reached by the seven specialized panels among which the Committee's work was divided. The final chapter is a brief recounting of the major events of the Alaska earthquake and its aftermath, to call to mind the experience on which the recommendations are based.

Pub. 1969, 35p. Printing and Publishing Office, Natl. Academy of Sciences, Wash. D.C.

Abstract provided by FDAA

SUPPORTED BY Natl. Academy of Sciences - Washington

3.0187, SEISMIC DESIGN FOR BUILDINGS

UNKNOWN, U.S. Army, Washington, District of Columbia

This updated manual was prepared to govern design of facilities for the U.S. Army, Navy and Air Force in areas subject to seismic events and supersedes the March 1966 issue. It was the intent not only to state basic criteria, but to also provide consistent extension of short-form requirements, commentary and design examples for design for resistance to earthquakes. Methods and factors specified were selected to provide sound design against earthquakes for most structures at relatively low cost. More highly refined techniques for many areas of design are not covered but their use is not precluded in the manual.

A basic citation is made to the 'Recommended Lateral Force Requirements and Commentation' by the Structural Engineers Association of California (SEAOC). Some of the concepts and applications added for general earthquake-resistant design practice are the design of supports for mechanical and electrical elements within and adjacent to structures, recognition of differences in overall loss potential for facilities, and application of, for high loss potential facilities, higher acceleration forces than previously used for certain areas. Other new considerations for general practice are included.

The proponent agency of this manual is the Office of the Chief of Engineers. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications) to HQDA (DAEN-MCE-A) WASH DC 20314.

Pub. April 73; 420p., Army TM 5-809-10, Navy NAV FACP. 355, Air Force AFM 88-3, Chap. 13.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Defense - Army

3.0188, BUILDING PRACTICES FOR DISASTER MITIGATION

C.G. CULVER, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234

Reasons for starting or progress last year: Land use and construction regulations containing strong disaster mitigation features can in the long-run alleviate losses by natural disasters. This program focuses on earthquake and extreme wind hazards and deals with building practices relative to new and existing buildings for mitigating losses.

One portion of the project culminated in a report (BSS 46, Building Practices for Disaster Mitigation) which evaluates

a second portion, a computer-driven evaluation of existing building natural hazards evaluation of existing buildings developed. Data collection forms for use in buildings were also developed. Simplified analytical methods for building evaluation are under development.

Approach: The current activities focus on developing a comprehensive seismic code applicable to all areas of the United States. Leading design professionals, research organizations and technical organizations indicated that the development of an improved code is a high priority item in any effort toward reducing future life and property loss resulting from earthquakes. The NBS in consultation with the professional and research community will conduct a program to develop and implement a comprehensive national seismic code. Provisions contained in the code would include all aspects of building systems, structural as well as non-structural, and applicable geotechnical practices. It is based on the performance concept clearly setting the level of risk associated with the various code provisions.

Expected results: The methodology for survey and evaluation of existing buildings will be completed and a comprehensive report detailing the technical procedures involved will be produced.

For the seismic code activities, a detailed work plan will be developed, task committees will be organized and initial drafts of the code provisions developed.

SUPPORTED BY U.S. Dept. of Commerce - N.B.S.

3.0189, STRENGTH OF EXISTING MASONRY WALLS

S.G. FATTAL, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234 (461)

Reasons for starting or progress last year: In FY73, completed a study on behalf of the Veterans Administration to assist them in developing a methodology for determining the in-plane and out-of-plane flexural strengths of masonry elements in existing VA hospital buildings to ensure structural integrity in earthquakes. In FY73 a contract extension was negotiated for additional NBS technical assistance in FY74 in: (a) developing an alternate sampling method for evaluation of flexural strength; (b) assessing limiting deflections of masonry partitions; (c) examining an approach for evaluation of critical stress conditions in existing VA buildings under seismic loads.

Approach: The approach will be similar to that used in the initial study. A literature survey will be used to prepare a synthesis of experimental and analytical data and to develop a methodology for reliable and consistent prediction of strength and stiffness of masonry walls in existing VA structures.

Expected results: This study will begin in July 1973 and a draft will be submitted to VA by the end of September 1973. The final report incorporating the findings of the FY73 and FY74 projects is expected to be submitted to VA by the end of FY74.

SUPPORTED BY U.S. Veterans Administration

3.0190, INELASTIC RESPONSE OF BUILDINGS TO SEISMIC STRUCTURAL RESTORATION

S.G. FATTAL, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234

Reasons for starting or progress last year: The objective of this project is to evaluate the recommendations of the proceedings of the Workshop on Building Practice for Disaster Mitigation.

clude avoidance of human distress and reduction of property loss caused by natural disasters. Recommendations B43 and B45 underscore the need for experimental research into the inelastic response of structural elements to define strength, ductility, and damping characteristics. Recommendation B28 stresses the need for improved technology to restore damaged buildings. The lack of adequate experimental basis in this area is further evidenced by the current efforts of the Veterans Administration and other Government agencies in their search for methods to strengthen existing structures and to repair buildings damaged in past disasters. The objective of this project is to implement the recommendations described herein.

Approach: To meet the dual objectives of investigating the inelastic response of structural elements and the structural effectiveness of repair technology this project will consist of three phases. Phase 1 will comprise an extensive interaction, through an NBS workshop, with agencies having major interest and involvement in structural rehabilitation, in order to document the current state of technical knowledge and existing practice and to define the gaps in this knowledge for preparation of the second phase. Phase 2 will be an extensive experimental program which will include (1) testing of structural elements under cyclic loading in the inelastic range to study degradation of strength, ductility and energy dissipative capacity; (2) repair and testing elements subjected to prior testing history defined in (1) to determine the degree of restoration achieved, and (3) testing of methods strengthening various structural types such as application of epoxy to repair concrete elements. Phase 3 will be an extensive documentation of test results and their synthesis to provide criteria for evaluating structural response of elements and recommended procedures for their repair and restoration of strength.

Expected results: Phase 1 will be started and completed this fiscal year. Phase 2 will start in the last quarter of this fiscal year.

SUPPORTED BY: U.S. Dept. of Commerce - NBS

3.0191, DESIGN, SITING, AND CONSTRUCTION OF LOW-COST HOUSING AND COMMUNITY BUILDINGS TO BETTER WITHSTAND EARTHQUAKES AND WINDSTORMS

W.F. REPS, U.S. Dept. of Commerce, Centet for Building Technology, Washington, District of Columbia 20234

Abstract: The report provided technical information regarding characteristics of materials and building systems, and discusses the structural performance of buildings subjected to the action of earthquakes and wind forces with specific reference to structures typical of developing countries. Potential ways are described in which structures can be made more resistant to such action. Siting considerations are discussed from a geological, seismic and climatological viewpoint, and recommendations relating to siting problems are made. Techniques of housing construction, both traditional and industrialized, are described and improvements resulting in better earthquake or windstorm resistance are suggested. Building codes, their improvement and their enforcement are also discussed.

Pub. Jan 74: 153p., NTIS No. Com-74-50184/2: PC-GPO MF \$1.45 NTIS

This project will concentrate on updating, expanding and substantially revising the present seismic code to incorporating recent research results. Code goals will be developed and clearly set forth such that appropriate regulatory bodies can recognize the level of risk associated with the various code provisions. The expanded comprehensive seismic code will cover all aspects of building and geotechnical practices to mitigate the effects of earthquake disasters. Provisions for architectural, mechanical and electrical features of construction will be included. Considerations of seismicity, geologic and soil site effects, and soil structure interaction will be incorporated. The required loading criteria and performance criteria will be explored in depth and codified. Design procedures for structures other than those presently contemplated by the code will be made. A detailed commentary on the code will be prepared.

SUPPORTED BY: U.S. Natl. Science Foundation

3.0193, EARTHQUAKE DESIGN FOR MASONRY STRUCTURES

I.Y. YOKEL, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234 (46) 5364

Reason for starting or progress last year: The project was successfully promoted and funds were obtained from industry to support the first year's effort. Preliminary meetings were held by professionals and industry representatives to plan strategy and initial steps were taken in an effort to obtain support from other federal agencies.

Approach: The project will have three phases: (1) A state-of-the-art study will compare existing standards, codes, and informal design practice with the state-of-the-art, compile test information, identify gaps in knowledge and information that must be filled by additional research, and develop interim design recommendations; (2) A test program, designed to develop information on such parameters as strength, stiffness, ductility and damping and evaluate the performance of various design details; (3) The synthesis of results and development of design criteria that can be proposed for adoption in codes and standards.

Expected results: In FY 74 work will commence on the state-of-the-art study and gaps in knowledge will be identified in order to develop the information required for the start of the testing in spring, 1974.

SUPPORTED BY: Natl. Concrete & Masonry Assn. - Arlington

3.0194, DESIGN CRITERIA FOR MASONRY

F.Y. YOKEL, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234

Reasons for starting or progress last year: A draft report 'Strength of Masonry Walls under Compression and Flexure' was prepared by Dr. Fattal and is currently under review in the Section. Dr. Yokel became Chairman of ANSI Committee A 41. Dr. Fattal became member of ACI Committee 531. An experimental investigation of anchorage of masonry veneers was started by Mr. Cattaneo following a review of the literature. A cooperative program of research between industry and the Federal Government has been established by NBS to develop improved procedures for the design of masonry structures in seismic regions. This project responds to the need for more information on the response of masonry struc-

of all participants. The task phases are: (1) an initial study will compare existing standards, codes, and ad hoc design practice with the state of knowledge, compile information, identify gaps in knowledge and information that must be filled by additional research, and develop interim design recommendations; (2) a research program, based on the conclusions from (1) and designed to develop information on such parameters as strength, stiffness, ductility and damping, and to evaluate the performance of various design details; (3) the synthesis of results and development of design criteria that can be proposed for adoption in national standards.

SUPPORTED BY U.S. Dept. of Commerce - N.B.S.

3.0195. FULL SCALE TEST ON A TWO-STORY HOUSE SUBJECTED TO LATERAL LOAD

F. Y. YOKEL, U.S. Dept. of Commerce, Building Research Div., Washington, District of Columbia 20234

Abstract: Tests were carried out on a house to determine its deflection characteristics under lateral loads. The house is a two-story building of conventional wood-frame construction. Two series of tests were conducted. The first of these was to determine the stiffness of the house when subjected to a simulation of wind loading. The second was to determine the dynamic response of the house to a single impulse load. The report presents the results of these tests.

Pub. Mar. 73, 30p., NTIS No. COM-73-50315; PC-GPO MF \$0.95-NTIS

SUPPORTED BY U.S. Dept. of Commerce - N.B.S.

3.0196. REPORT ON EARTHQUAKE INSURANCE TO CONGRESS OF UNITED STATES - PURSUANT TO SECTION FIVE OF SOUTHEAST HURRICANE DISASTER RELIEF ACT 1965

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Fed. Insurance Administration, Washington, District of Columbia 20410

Abstract: Although California and Alaska are more vulnerable to earthquakes than other States, all but a few have experienced some earthquake activity. A severe earthquake in a densely populated area could cause heavy loss of life and billions of dollars of property damage. Earthquake insurance is readily available on one to four family dwellings throughout the United States. Earthquake insurance premiums on dwelling properties are neither excessive nor unreasonable. Earthquake insurance on commercial and industrial properties is available, but its availability is limited because of the exposure. A broader program than that now offered by the private insurance industry is precluded by present deficiencies in knowledge and data concerning earthquake occurrences and by the inadequacy or absence of land use and control measures to reduce earthquake losses.

Pub. 1971: 120 p., NTIS No. PB - 206 791; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

3.0197. SEISMIC HAZARDS AND LAND-USE PLANNING

D. R. NICHOLS, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Basic earth-science data are necessary for a realistic assessment of seismic hazards and as a basis for limiting corrective land-use controls only to those areas of greatest hazard. For example, the location, character, and amount of likely displacement and activity of surface faulting can be predicted if detailed geologic maps are available.

surface and subsurface conditions. They should be located off active fault traces, varying with the character of faulting, the extent of the fault, which fault traces are known, and the importance of the structure. Recreational activities and other important land uses should be considered for fault zone areas. Land is under pressure for development; otherwise, areas should remain as open space.

Two methods of predicting ground shaking effects are cited for application to land-use decisions: (1) Relative earthquake hazard can be related to firmness of the ground and can be used as a gross way to allocate population density in the more sophisticated analyses, and (2) intensity maps (a) damage from former earthquakes, or (b) analyses of geologic units added to a design earthquake hazard map. Analyses of geologic units added to a design earthquake hazard map are helpful both for general and specific plans. Analyses of geologic units are used with caution to predict ground shaking effects on critical structures to be located at specific sites and foundation conditions. Fully adequate methods of predicting possible shaking remain to be developed. Where land-use decisions do not reflect likely ground shaking effects, more stringent building codes are needed, particularly for critical structures.

Ground failure (landsliding, ground cracking and differential settlement, sand boils, and subsidence) results from liquefaction, loss of soil strength, or erosion. Areas suspected of being most likely to fail should be developed unless detailed site studies can demonstrate that hazard does not exist or can be overcome. Various measures can be used to reduce the high, long-term public hazard from development of unstable ground. However, effects of tectonic deformation generally cannot be avoided, nor can effects of such deformation be minimized.

Large water waves, such as produced by tsunamis, sea dam failure or overtopping, can be anticipated in some places. (Text Abridged)

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0198. PROGRAM DESIGN 1971 - SAN FRANCISCO BAY REGION ENVIRONMENT AND LAND-USE PLANNING STUDY

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Abstract: A comprehensive guide to a study of the San Francisco Bay Region describes a 4 year demonstration study conducted jointly by the Geological Survey and the Department of Housing and Urban Development designed to improve urban development decisions through use planning through application of innovative concepts. Urban-related environmental studies include faults and earthquake hazards, landslides and slope stability, physical and chemical properties of San Francisco Bay and its circulation patterns, water quality and pollution subject to flooding, water supply and waste disposal, and available mineral and water resources. Planning elements described include state-of-the-art review, a feasibility study of incorporating earth-science data into urban planning information systems, and application of demonstration studies.

Pub. Oct. 71: 121p., NTIS No. PB-206 826; PC \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0199. PROTECTION OF TRANSPORTATION

UNKNOWN, U.S. Dept. of Transportation, Natl. Transportation Safe. Bd., Washington, District of Columbia 20591

Abstract: The study is an examination of Federal involvement in the earthquake field, specifically in the transportation field. The study discusses the need for reexamination of the criteria used in the design of transportation structures, stepped-up earthquake-related programs, and better coordination between Federal agencies. It also discusses earthquake history in the United States, existing standards for earthquake-resistant design and construction of transportation systems, and possible modifications to existing transportation structures.

Pub. Feb. 72: 41p., NTIS No. PB-210 270; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Transportation - N.T.S.B.

3.0200, REPORT OF THE TASK FORCE ON EARTHQUAKE HAZARD REDUCTION PROGRAM PRIORITIES

K.P. STEINBRUGGE, U.S. Exec. Office of the Pres., Off. of Science & Technology, Washington, District of Columbia 20006

The report presents and discusses the Task Force's 20 high priority recommendations comprising a National Action Program for the reduction of human suffering and property damage attendant upon an earthquake, including the earthquake-associated geologic and non-geologic hazards.

Pub. Sept. 1970: 54p., No copy info. available.

Abstract provided by FDAA.

SUPPORTED BY U.S. Executive Office - O.S.T.

3.0201, EARTHQUAKE RESISTANT DESIGN REQUIREMENTS FOR VA HOSPITAL FACILITIES

UNKNOWN, U.S. Veterans Administration, Hospitals Clinics & Reg. Off., Washington, District of Columbia 20420

This handbook sets forth requirements for earthquake resistant design of VA hospital facilities. The requirements are derived from current research in earthquake engineering, the advice of specified consultants, and the technical expertise of the members of the VA Earthquake and Wind Forces Committee. The seismic design requirements are based on the Uniform Building Code and include provisions which are in addition to those in the Uniform Building Code. These requirements will be included in a full study report which is planned for publication in 1974.

Pub. March 74: 36p., Handbook H-08-8.

Abstract provided by FDAA.

SUPPORTED BY U.S. Veterans Administration

3.0202, A STUDY OF MICROEARTHQUAKES IN THE SOUTHEASTERN UNITED STATES

L.T. LONG, Georgia Inst. of Technology, School of Geosciences, Atlanta, Georgia 30332

The Southeastern United States is an area of infrequent occurrence of large earthquakes. The sparsity of data, particularly the lack of quality seismic stations, hinders the evaluation of seismicity and seismic risk and hinders the evaluation of focal mechanisms. The importance of data on seismicity and earthquake mechanism is emphasized by the potential for

areas. Over the past year data has been obtained in the field with smoked-paper microearthquake technique in the Southeast United States. Coupled with studies of 'b' values and magnitudes these preliminary studies indicate that the technique appears to have the greatest potential significance in obtaining focal mechanisms and aftershock locations. Consequently, the proposed research will emphasize continuation of earthquake monitoring in known active areas and detailed studies of large events (ML approximately greater than 3) in the Southeast.

SUPPORTED BY U.S. Natl. Science Foundation

3.0203, EARTHQUAKE EFFECTS ON STRUCTURES

J.D. PRENDERGAST, U.S. Army, Construction Engin. Res. Lab., Champaign, Illinois 61820

Develop an appendix for TM 5-809-10, 'Seismic Design For Buildings' which prescribes a more rigorous and improved seismic design procedure to be utilized in the design of critical military facilities (hospitals, communication centers emergency power stations, fire stations, etc) located in regions of high seismicity.

The procedures and tools required by a designer to implement a more rational seismic design method will be developed. The seismic design method will prescribe procedures for establishing a definition of the seismic input for critical military structures in the form of a design ground-motion spectrum, illustrate the various methods for utilizing the design ground-motion spectrum in the design and analysis process, provide the designer with the structural analysis techniques and procedures to evaluate and predict the basic earthquake performance of structural systems comprising critical facilities, and establish structural design criteria which limits the deformation levels at which earthquake forces are to be resisted by the structure.

Supporting agency address information: OCE Construction Engineering RES Lab, Champaign, IL 61820

SUPPORTED BY U.S. Dept. of Defense - Army

3.0204, TECHNIQUES FOR RETROFITTING EXISTING BRIDGE STRUCTURES TO REDUCE THE SUSCEPTIBILITY TO EARTHQUAKE DAMAGE

ROBINSON, IIT Research Institute, Chicago, Illinois 60616 (045304)

The purpose of the study is to identify and define, through structural analyses and supporting laboratory tests, practical techniques and criteria for retrofitting existing bridges to increase their resistance to seismic forces. Task 1: Bridge selection, definition of seismic environments and preparation of analytic models. Task 2: Seismic Analysis. Task 3: Identification of failed components bridge rating. Task 4: Develop retrofit concepts and determine relative costs. Task 5: Laboratory Experiments. Task 6: Refinement of Retrofit Concepts.

Document provided to S.S.I.E. by the T.R.A.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

3.0205, STRESS-STRAIN RELATIONSHIPS OF REINFORCING BARS SUBJECTED TO LARGE STRAIN REVERSALS

A.E. AKTAN, Univ. of Illinois, School of Engineering, Urbana,

3.0206.

SUPPORTED BY U.S. Natl. Science Foundation

3.0206, EFFECTS OF TWO-DIMENSIONAL EARTHQUAKE MOTION ON A REINFORCED CONCRETE COLUMN

A. E. AKTAN, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

Abstract. Although there has been a considerable number of studies on the dynamic response of reinforced concrete in recent years, effects of multi-dimensional interaction on the dynamic response of reinforced concrete have received virtually no attention. This study was carried out to obtain information on the static and dynamic multi-dimensional response of reinforced concrete. A finite-filament model was developed for this purpose. This model assumes a column segment to consist of filaments along its long axis and develops the system properties through the stress-strain hysteresis characteristics and history of these filaments during analysis.

Pub. May 73 141p., NTIS No. PB-220 89176; PC \$5.45 MF \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

3.0207, SEISMIC BEHAVIOR OF FRAMED TUBES

J. C. ANDERSON, Univ. of Illinois, Graduate School, Urbana, Illinois 61801

The framed tube is a relatively new concept in building design in which the exterior frames of the structural system consist of closely spaced columns connected by spandrel shear beams. The purpose of this research is to design framed tube structures for typical reinforced concrete buildings and to evaluate their inelastic behavior when subjected to strong ground motions. The framed tubes are designed for combinations of dead load, live load, wind load and earthquake load as specified in the Uniform Building Code.

All members are assumed to follow a bilinear hysteresis curve which includes the following two modifications: (1) the influence of axial load on the yield moment of the columns is considered using an interaction diagram and (2) the influence of stiffness degradation is considered by relating the elastic stiffness to the ductility requirement. The inelastic behavior of the structure is evaluated in terms of the following response parameters: ductility requirement of the spandrel beams, ductility requirement of the columns, maximum story displacement, maximum story in story displacement, maximum plastic rotation of beams and columns and maximum envelope of story shear.

SUPPORTED BY University of Illinois

3.0208, PROBABILISTIC METHODS IN CIVIL ENGINEERING

A. H. ANG, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

Existing risk and reliability models will be applied to the evaluation of safety and performance of structures subjected to dynamic forces of natural hazards. Specific studies will include: (1) The evaluation of risks implied in current structures built to resist specific natural hazards, e.g., structures that are designed to resist earthquakes in accordance with current seismic provisions. This will require the evaluation of risk and reliability of structural components designed accord-

ing to existing provisions, and additional models developed which for specific types of systems. (3) Finally, a stochastic method will be developed for the practical dynamic analysis of multi-degree-of-freedom systems, to probabilistic response information required in the evaluation of risk to dynamic natural hazards.

SUPPORTED BY U.S. Natl. Science Foundation

3.0209, ANALYSIS OF LIQUEFACTION OF GRANULAR SOILS DURING EARTHQUAKES

J. GHAROUSI, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

The saturated granular soil is modeled as a fluid-solids system. Nonlinear material properties are assigned to the soil in order to simulate the stress dilatancy of the soil under shear deformation which is an important factor contributing to pore pressure build-up leading to liquefaction. Finite element is used for spatial discretization and the nonlinear matrix equation of motion is integrated by a time-marching integration scheme. The research is to develop methodology for the assessment of liquefaction potential in soil structures and structures subject to arbitrary dynamic loading.

SUPPORTED BY University of Illinois

3.0210, RESPONSE AND ENERGY DISSIPATION OF REINFORCED CONCRETE FRAMES UNDER STRONG BASE MOTIONS

P. GULKAN, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

Abstract. The report contains tests and analyses of reinforced concrete frames subjected to simulated earthquake motions. Pub. May 71: 104p., NTIS No. PB-212 946; PC \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

3.0211, EARTHQUAKE EFFECTS ON REINFORCED CONCRETE BUILDINGS

M. A. SOZEN, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

This amendment to NSF grant GK-35486-X covers the completion of the research begun under the original grant. This research is aimed at the general objectives of understanding and formulating analytically the energy dissipation mechanisms of reinforced concrete structures subjected to destructive earthquakes and introducing two important features: axial loads and multi-story frames.

A number of experiments will be run making use of an earthquake simulator. Two basically different loading will be used in the tests: inertia loading by imposing displacements. In other case, the specimens are developed in a mass attached to the specimen inducing accelerations at the base of the specimen. In the other and simpler case, the specimen is loaded by imposing a deformation at a prescribed level. This loading is necessarily a dynamic test and is carried out on the earthquake simulator. The imposed deformation involves rapid or slow (static) loading.

SUPPORTED BY U.S. Natl. Science Foundation

MAJOR DISASTER TYPES

The main objective is to improve the structural design and construction process as related to earthquake-resistant design. During the first two year research included: (1) tests on half-scale spirally reinforced concrete columns, (2) an experimental investigation of the hysteretic behavior of reinforcing bars, (3) an inelastic dynamic response analysis of the main building of the Olive View Medical Center, (OVMC), (4) a pilot study to estimate the effect of horizontal two-dimensional motions on the response of the main building of OMC, and (5) exploratory studies for the development of an attractive model for a design method, i.e., the substitute damping method. During the third year, the research will include (1) testing of a series of five reinforced concrete models (representing 3-story structures having structural walls and frames) dynamically and statically to provide basic information for the development of a generally applicable design method, (2) subjecting reinforced concrete columns to simultaneous base motion in two horizontal directions, and (3) the development of the substitute damping method into a generalized design method.

SUPPORTED BY U.S. Natl. Science Foundation

3.0213, PROBABILISTIC MODELING OF EXTREME LOADS

Y.K. WEN, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

This project deals with probabilistic modeling and risk analysis of extreme environmental loads caused by tornadoes, hurricanes and earthquakes. The physical aspects of the natural phenomena which cause these loads are incorporated into the formulation and the occurrences of these loads are modeled by random processes. The results are presented in a form suitable for practical applications.

SUPPORTED BY University of Illinois

3.0214, SHEAR STRENGTH DECAY IN REINFORCED CONCRETE COLUMNS SUBJECTED TO LARGE DEFLECTION REVERSALS

J.K. WIGHT, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

Abstract: The report contains an analysis of a series of tests of reinforced concrete columns subjected to cyclic loading.

Pub. Aug 73: 309p., NTIS No. PB-255 483/7; PC \$7.00 MF \$1.45.

SUPPORTED BY U.S. Natl. Science Foundation

3.0215, PROBABILISTIC ANALYSIS OF ELASTO-PLASTIC STRUCTURES

T.L. PAEZ, Purdue University, School of Civil Engin., Lafayette, Indiana 47907

Abstract: The consideration of dynamic loads due to wind storms or strong earthquakes can be significant in the safety analysis and design of structures. When these extraordinarily large loads occur, the behavior of most structures is nonlinear and often results in plastic deformations. Because excessive deformations could cause a structure to fail, it is important to study the structural response beyond the linearly elastic range by applying probabilistic methods in the solution of structural engineering problems. A method is presented for computing the first-passage probabilities for linear and nonlinear structures. In addition, the probability

3.0216, SHEAR MODULUS AND DAMPING DESIGN EQUATIONS AND CURVES

B.O. HARDIN, Univ. of Kentucky, School of Engineering, Lexington, Kentucky 40506

Abstract: Equations and graphs for the determination of modulus and damping of soils, for use in design involving repeated loading or vibration of soils, are presented. These equations and graphs are based on numerous triaxial tests on both remolded and undisturbed cohesionless soils on clean sands. Comparison of the measured values shows good agreement. An example problem shows how these equations and curves are used in design.

Pub. Jul 70: 56p., NTIS No. PB-193 608; MF \$0.60

SUPPORTED BY U.S. Natl. Science Foundation

3.0217, DENVER EARTHQUAKES

L.E. GARONO, U.S. Army, Edgewood Arsenal, Maryland

Abstract: The paper reviews the question of waste disposal by the Rocky Mountain Arsenal and the microearthquakes in the area.

Pub. 1970: 14p., NTIS No. AD-713 526; HC \$3.00

SUPPORTED BY U.S. Dept. of Defense - Army

3.0218, RESEARCH STUDIES AND RECOMMENDATIONS FOR EARTHQUAKE HAZARDS REDUCTION

S.T. ALGERMISSEN, U.S. Dept. of Commerce, National Oceanic & Atmos. Admin., Rockville, Maryland 20852

Objectives of the project include validation, refinement and extension of existing techniques for the evaluation of earthquake losses to structures; state-of-the-art seismic risk zoning; and to provide information and recommendations for action and research leading to earthquake hazard reduction through seismic zoning and appropriate land-use practice and control design criteria and building codes.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

3.0219, SEISMIC RISK STUDIES IN THE UNITED STATES

S.T. ALGERMISSEN, U.S. Dept. of Commerce, National Oceanic & Atmos. Admin., Rockville, Maryland 20852

Abstract: A new Seismic Risk Map of the United States is presented, together with strain release and Modified Mercalli intensity maps of the country. The occurrence of damaging earthquakes was not considered in assigning ratings to the various zones on the map. The studies of earthquake frequency are included in the risk map. The Seismic Risk Map is a revision of the Seismic Probability Map prepared by the Coast and Geodetic Survey in 1947 and withdrawn in 1964.

Pub. Jan. 69: 23p., NTIS No. COM-71-00106; MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

3.0220, ALEUTIAN SEISMICITY - MICROSEISMIC EFFECTS

E.R. ENGDAHL, U.S. Dept. of Commerce, National Oceanic & Atmos. Admin., Rockville, Maryland 20852

A review of the spatial and temporal characteristics

3.0221.

tion are by a moving oceanic plate. The careful monitoring of earthquake patterns preceding and following MILROW revealed no evidence for any significant spatial or temporal changes in the natural seismicity. There occurred, however, immediately after detonation, in a zone not more than 3 miles in radius from ground zero, a swarm of hundreds of very small earthquakes which terminated abruptly 37 hours later at the time of the MILROW cavity collapse. Since they were very small, of short duration, and occurred in the immediate vicinity of the explosion, they are not believed to constitute a hazard to the major fault zone under Amchitka Island.

Pub. May 70: 59p., NTIS No. CGS-746-102; PC \$5.00 MF \$1.45

SUPPORTED BY U.S. Atomic Energy Commission

3.0221. THE FAIRBANKS, ALASKA, EARTHQUAKES OF JUNE 21, 1967

J. N. JORDAN, U.S. Dept. of Commerce, Natl. Ocean Survey, Rockville, Maryland 20852

Abstract. On June 21, 1967, at 18.04:49.5, 18.13:02.9, and 18.24:45.7 Greenwich Mean Time, the Fairbanks region was shaken by three earthquakes of magnitudes 5.4, 5.6, and 5.4, respectively. The report is a preliminary interpretation of seismological data from permanent seismograph stations throughout the world, temporary seismograph and strong-motion seismograph stations established in the epicentral area, seismoscopes, intensity reports, and inspection of the epicentral area. Results from one accelerometer record and ten seismoscope records are presented in this preliminary engineering report in context with effects of the earthquake as determined by field investigation and questionnaire canvass.

Pub. 1973: 67p., NTIS No. COM-73-114464; PC \$5.50 MF \$1.45

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3.0222. IMPROVED BODY-WAVE MAGNITUDES OF ALEUTIAN EARTHQUAKES

A.C. TARR, U.S. Dept. of Commerce, Natl. Ocean Survey, Rockville, Maryland 20852

Uncertainties in routine PDE Mb estimates of Aleutian earthquake magnitudes often reflect the effects of station-source region biases and station detection-threshold magnitudes. Examination of magnitude data from aftershocks of the February 27, 1970, Aleutian Trench earthquake indicates that magnitudes of small aftershocks were consistently underestimated, since these events were observed primarily by Western United States stations having negative biases. The same general pattern is observed elsewhere in the Aleutian arc. Quantitative estimates of the station-source region biases using over five years of short-period P amplitude data confirm these observations. Correction for the station-source region bias significantly reduces the dispersion of station magnitudes about the mean and, in some cases, shifts the mean by as much as 0.3 magnitude unit.

Pub. May 71: 47p., NTIS No. CGS-746-115; PC \$4.50 MF \$1.45

SUPPORTED BY U.S. Atomic Energy Commission

3.0223. ALEUTIAN SEISMIC PROGRAM SEISMOLOGICAL BULLETIN, MARCH 1971

occurrence in the Aleutian Islands. Record arrival amplitudes were scaled by the Special Project, Las Vegas, Nevada. Final reduction and collation of hypocenters and derivation of related parameters framed by the Seismology Investigations Group, Maryland. This compilation is preliminary and subject to later revision on the basis of current research.

Pub. Jan. 72: 93p., NTIS No. CGS-746-132; PC \$0.95

SUPPORTED BY U.S. Atomic Energy Commission

3.0224. ALEUTIAN SEISMIC PROGRAM - SEISMOLOGICAL BULLETIN, MARCH 1971

UNKNOWN, U.S. Dept. of Commerce, Environ. Laboratories, Rockville, Maryland 20852

Tabulated preliminary data acquired during March 1971 from an Aleutian network of seismic stations are presented in order to facilitate current studies of earthquakes in the Aleutian Islands. Each table includes information on date; station; phase; time of arrival of phase; group velocity; amplitude; period of phase; station magnitude; distance to event; station-to-epicenter azimuth; time residual; and descriptive remarks. Six tables are presented covering the Aleutian Islands from Unalaska Island to Unimak Island on which are plotted earthquakes which were located during the month of March 1971. The tables are also indexed by the Aleutian seismic network and by a world-wide seismicological stations.

Pub. Jan. 72: 73p., NTIS No. CGS-746-118; PC \$0.95

SUPPORTED BY U.S. Atomic Energy Commission

3.0225. SEISMIC RESEARCH

R. MILLER, Stone & Webster Engin. Corp., Boston, Massachusetts 02109

Description: To develop methods for determining properties and dynamic response of soils under earthquake conditions. To investigate soil liquefaction and relate results to determining liquefaction potential at reactor sites from laboratory triaxial and other tests. To develop guideline procedures for evaluating seismicity of soils at potential reactor sites. To evaluate methods used in all steps of the process of seismicity of a nuclear power plant and determine margins attributable to the various methods used. To validate predictions of structure, system, and component response through testing, where feasible. To provide standards for analytical methods to be used in seismicity of nuclear power plants.

SUPPORTED BY U.S. Atomic Energy Commission

3.0226. SEISMIC GROUND EFFECTS IN THE NEW THEORIES OF TECTONICS AND EARTH MECHANISM

K. AKI, Mass. Inst. of Technology, School of Science, Cambridge, Massachusetts 02139

The ultimate aim of the proposed research is to determine maximum seismic motion expected at a given location available information on the physical conditions of an earthquake fault zone on the basis of latest theoretical

on surface motion, and (4) The mechanism of stress concentration before an earthquake occurrence. Study in all of the above mentioned areas will be continued.

SUPPORTED BY U.S. Natl. Science Foundation

3.0227. INELASTIC DESIGN OF BUILDING FRAMES TO RESIST EARTHQUAKES

J.E. ISHELL, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

The study described in this report was aimed at better understanding the relationship between design strategy and damage during strong earthquakes, and in the development of improved design strategies.

This is the twelfth in a series of reports covering research supported by the National Science Foundation under Grants GK-27955 and GI-29936, as part of the program for Research Applied to National Needs (RANN).

This study involves the development of a design procedure which allows control of the inelastic response of a building. The story ductility ratios and interstory displacements are used as a measure of this control, as these parameters seem directly related to possible collapse and overall damage in the building as the result of a severe earthquake. The building is reduced to a simple spring-mass model. Various design procedures involving Newmark's inelastic response spectra are used to design the stiffness and resistances of the springs. A dynamic analysis of the design models subjected to artificial earthquake motions is made to determine the effectiveness of the design procedures. Newmark's inelastic spectra are also evaluated. A design procedure is developed which gives control over the average values of interstory displacement and ductility ratio, but the desired uniformity of these parameters is not achieved. It is also concluded that to limit maximum values of parameters inelastic spectra should be made more conservative.

Pub. May 74; 136p., Seismic Design Decision Analysis Report No. 12; Dept. of Civil Engineering, Mass. Inst. of Technology, Cambridge, Mass. 02139 PC \$3.00

Abstract provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

3.0228. NONLINEAR AND COUPLED SEISMIC EFFECTS

J.M. ROESSET, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

Description: The purpose of this research program is to investigate nonlinear soil effects in soil amplification of earthquake motions and the effects of layering and embedment on soil structure interaction effects. This last effect is particularly significant in the earthquake design of nuclear reactors. Finite element techniques are being used to represent the subsoil and the structure and different boundary conditions to reproduce radiation effects are being compared.

SUPPORTED BY U.S. Natl. Science Foundation

3.0229. SEISMIC DESIGN DECISION ANALYSIS FOR EASTERN METROPOLITAN AREAS

R.V. WHITMAN, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

The overall objective of this award is to develop a systematic methodology for making decisions concerning the proper

ing future earthquakes. Working within the constraints imposed by realistic public and private policy, the award will specifically seek: 1. To develop reliable data concerning the tangible costs and benefits of designing for increased seismic resistance. 2. To develop probabilistic models for analyzing and comparing the costs and benefits of various strategies for mitigating the consequences of future earthquakes. 3. To work with engineers, building officials and public bodies to learn how such data and results can be used as a basis for making decisions about seismic design requirements.

SUPPORTED BY U.S. Natl. Science Foundation

3.0230. METHODOLOGY AND PILOT APPLICATION

R.V. WHITMAN, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

This is the tenth in a series of reports covering work supported by the National Science Foundation under the program of Research Applied to National Needs (RANN), under NSF Grants GK-27955 and GI-29936.

A shortened description of the methodology and pilot application has already appeared in Report 9. Chapter 4 of this report, dealing with the treatment of seismic risk, will also be released separately as Report 11. Chapter 5 is a summary of the development of the damage probability matrices; a complete description appears in Report 8. This report contains (in chapter 6) a complete mathematical formulation of the methodology, and also (in Chapter 8) the first reporting of the studies using multiattribute decision theory.

The aim is to assemble and process the data necessary for a rational choice of required earthquake design requirements in building codes. Procedures are developed to quantify the risk of earthquake shaking, the likelihood of building damage, and the cost of increasing the required earthquake resistance of buildings. Various measures of effectiveness are considered: cost/benefit with a dollar cost assigned to life loss; acceptable life loss and utility functions incorporating both dollar and life losses. As an illustrative, pilot application, the methodology is applied to the choice of design requirements for multi-story apartment buildings in Boston.

Pub. July 74; 181p., Seismic Design Decision Analyses Report No. 10; Dept. Civil Engineering, Mass. Inst. of Technology, Cambridge, Mass. 02139 PC \$3.00.

Abstract Provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

3.0231. EARTHQUAKE INDUCED TRANSIENT PORE PRESSURES IN EARTH DAMS

V.L. STREETER, Univ. of Michigan, School of Engineering, Ann Arbor, Michigan 48106

The primary thrust of this activity is to determine the loadings on the upstream sloping faces in earth dams due to water motion in the reservoir induced by earthquakes, and the development of a mathematical model to calculate the transient pore pressure due to dynamic loading. A one-dimensional model will be formulated, that will guide the development of two and possibly three dimensional lattice work analytic models. Dynamic loadings caused by reservoir water sloshing will also be calculated by the same methods, starting from displacements or velocities of the solid boundaries. The dynamic pore pressures will be combined with the total stresses through out the upstream slope, and the distribution of effective stresses will be calculated. The coupling

contribution of dynamic pore pressure to stability analyses of earth dams

SUPPORTED BY U.S. Natl. Science Foundation

3.0232. VERIFICATION OF EMPIRICAL METHOD OF DETERMINING RIVERBANK STABILITY (POTAMOLOGY INVESTIGATIONS - SOILS PHASE)

C. C. CALHOUN, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Purpose of study/investigation: To determine causes of major riverbank failures along the lower Mississippi river and to improve criteria for predicting soil conditions and susceptibility to liquefaction-type failures

Approach or plan: Boring logs and gradation data for reaches planned for revetment in the Memphis, Vicksburg, and New Orleans Districts are analyzed and potential susceptibility to liquefaction is predicted. Field surveys of riverbank failures furnished by the three districts are evaluated to determine type of failure (either shear or liquefaction induced flow slide), and previous predictions based on empirical criteria are evaluated

Progress to date: Annual reports were published on data from 1954 to 1968. Starting with the 1968 data, reports will be biennial. The first biennial report, Potamology Investigations Report 12-21, Verification of Empirical Method for Determining Riverbank Stability, 1968 and 1969 Data, is being published. The empirical criteria, modified in 1959, are used to classify fine sands into zone A and zone B, based on gradation, and to predict potential susceptibility to liquefaction if the zone A sand thickness is 20 ft. or more and the ratio of overburden thickness to zone A sand thickness is 0.85 or less. During 1968, the criteria were expanded to include the depth of thalweg for making predictions for locations in the New Orleans District. Since 1954, a total of 103 flow failures have been recorded within 500 ft. of analyzed boring locations, with 91 locations predicted to be susceptible and only 12 locations predicted to be stable. However, many locations predicted to be unstable have not experienced flow failure.

SUPPORTED BY U.S. Dept. of Defense - Army

3.0233. STATE-OF-THE-ART FOR ASSESSING EARTHQUAKE HAZARDS IN THE UNITED STATES. REPORT 1.

O.W. NUTTLI, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The earthquake risk problem in the Central United States, taken to be approximately the area east of the Rocky Mountains and west of the Appalachians, is discussed. The seismic history of the area is reviewed and is used to divide the area into various seismic regions. A design earthquake, defined as the largest earthquake that can be expected to occur within an area, is specified for each of the three seismic regions. Specification of the design earthquake is accomplished by giving ground displacement, particle velocity, and acceleration values in hard rock as a function of distance from the earthquake, for three particular wave frequencies. The results are presented in graphical and tabular form. A brief discussion of the effects of soil instability is included. The problem is of particular importance in the Mississippi and other major river valleys of the Central United States.

Pub. Jan. 73: 59p., NTIS No. AD-756 447. PC \$3.50 MF

F.C. TOWNSEND, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

To establish criteria evaluating the liquefaction susceptibility of soils under earthquake, blast, wave action, and loadings.

Published case histories of liquefaction failures would be collected, reviewed and evaluated to determine common trends - i.e., soil type, loading conditions, and hydraulic characteristics influencing these failures. Based upon these histories, a laboratory testing program utilizing dynamic monotonic triaxial tests, simple shear or shaking tables, will be conducted to determine common trends contributing to the liquefaction susceptibility of soils. Subsequent laboratory data would be the basis for a classification of soils, evaluating the liquefaction susceptibility and remedial measures for preventing liquefaction of soils.

Supporting agency address information: OCE, Waterways Experiment Station, P. O. Box 631, Vicksburg, MS 39180

SUPPORTED BY U.S. Dept. of Defense - Army

3.0235. SOME GROUND MOTION AND INTENSITY RELATIONS FOR THE CENTRAL UNITED STATES

A. NECIOGLU, St. Louis University, Graduate School, St. Louis, Missouri 63103

Abstract: Because of low absorption of seismic wave energy in the central United States as compared to the western United States, relations between ground motion and intensity differ between two regions. This paper presents some empirical relations between magnitude, intensity and perceptibility that are applicable in the central United States. In general, the relations between magnitude and of damage are one to two orders greater for earthquakes in the central area than for western earthquakes of equal magnitude or of equal maximum intensity.

Pub. 1974: 27p., NTIS No. COM-74-10804/4; Reprint.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3.0236. A MICROEARTHQUAKE STUDY OF THE LOWER MISSISSIPPI VALLEY - ARKANSAS, MISSISSIPPI AND TENNESSEE

O.W. NUTTLI, St. Louis University, Graduate School, St. Louis, Missouri 63103

This project is concerned with a study of microearthquake activity in western Tennessee, eastern Arkansas and northern Mississippi. One objective is to determine if there are earthquakes along an extension of the trend of the Madrid Fault System to 34 degrees N, 91 degrees W. An attempt to learn more about the southern limit of this system, and hopefully to delimit it. A second objective is to determine if there is seismic activity along the transverse trending Ouchita Tectonic Front and its westward (Vicksburg Mountain) and eastward (Appalachian Tectonic Front) extensions. The epicentral locations of past felt earthquakes suggest such a trend as being possible, but of themselves insufficient to establish that this tectonic feature represents an active fault zone.

In addition to the microearthquake study, focal mechanism solutions of earthquakes with M_h greater than 1.4 (about 100 in the past five years in the Mississippi Valley seismic zone) will be obtained from the spectra of long-period surface waves, with body-wave data serving as a constraint.

3.0237, MAGNITUDE RECURRENCE RELATION FOR CENTRAL MISSISSIPPI VALLEY EARTHQUAKES

O.W. NUTTLI, St. Louis University, Graduate School, St. Louis, Missouri 63103

Abstract: Earthquake magnitudes are estimated for all known felt earthquakes in the central Mississippi River valley seismic region for the interval 1833 through 1972. The resulting data set is examined for completeness, so that an estimate of the average number of earthquakes per year in a given magnitude interval can be determined. The resulting data yield a recurrence equation of the form: $\log N$ equals $3.69 + (0.89 \text{ plus or minus } 0.11) M_b$, at the 95% confidence limit, where N is the number of earthquakes per year occurring in the magnitude interval M_b plus or minus 0.2, for 3.3 less than or equal to M_b less than or equal to 6.3. Extrapolation of the curve by one M_b unit indicates that the return period for an earthquake the size of the three great Mississippi Valley earthquakes of 1811 and 1812 is about 500 years.

Pub. 1974: 38p., NTIS No. COM-74-10814/3; PC \$5.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3.0238, THE RELATION BETWEEN FELT AREA AND MAGNITUDE FOR CENTRAL UNITED STATES EARTHQUAKES

O.W. NUTTLI, St. Louis University, Graduate School, St. Louis, Missouri 63103

Abstract: In general, there is a nearly unique relation between magnitude and felt area of central United States earthquakes. To develop a quantitative relation, 22 recent earthquakes were studied, and an empirical equation was derived. The equation can be used to estimate the magnitude of earthquakes for which there are intensity maps but no instrumental data. From the equation one can determine that the limit of perceptibility corresponds to a sustained, hard rock, vertical-component particle velocity of about 22 micron/sec.

Pub. Feb. 74: 15p., NTIS No. COM-74-10808/5; Reprint.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

3.0239, TRAVEL TIME TABLES FOR EARTHQUAKES IN THE CENTRAL UNITED STATES

O.W. NUTTLI, St. Louis University, School of Engineering, St. Louis, Missouri 63103

Abstract: Travel-time tables for earthquakes occurring in the central United States and recorded in central and eastern North America are presented for distances from 0 to 1000 km. The tables are given for focal depths of 0.5, 15, 25 and 35 km.

Pub. Mar. 70: 13p., NTIS No. AD-706 427.

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0240, RESEARCH IN EARTH STRAINS AND FOCAL MECHANISMS - MISSOURI

W. STAUDER, St. Louis University, School of Arts, St. Louis, Missouri 63103

A strain observatory has been installed near Flat River, Missouri, about 70 miles South of Saint Louis. Operation has perfected under previous grants and has been recording high quality earth tidal and earth strain data since November 1969. Near-station micro-earthquake activity is being observed at the rate of about two shocks per day. Secular strain is predominantly an EW compression, accumulating at a rate as great as 10-6 per year.

mid-continent site, to study the earthquake relation to local seismicity, and to continue study of focal mechanisms in regions of significant spreading.

SUPPORTED BY U.S. Nat. Science Foundation

3.0241, SEISMIC STUDIES - SOUTH CENTRAL EARTHQUAKE OF NOVEMBER 9, 1968

H. STAUDER, St. Louis University, School of Engineering, St. Louis, Missouri 63103

Abstract: The largest earthquake to occur in the central seismic region this century took place in Illinois on November 9, 1968. The hypocenter time based on observations from twelve recording stations in epicentral distance from 171 to 37.95N, 88.48W, h equals 25 km, Q equals (1 sec) plus or minus 0.2 sec). Travel times of distant less than 2600 km indicate regional near corresponding to rays bottoming in depths down to 200 km. Beyond this point travel times show a much steeper dependence, if any, on region. For stations in the States P times may be fitted by two straight lines which intersect at about 600 km. The first responds to P_n , the second to rays refracted at depth 97 km with a velocity below it of 8.1 km/sec. At larger distances (48 - 100 degrees) there are independent residuals with respect to the Herrin T₀ about 0.25 percent SEC4 indicating a source correction with respect to these tables.

Publ. Dec. 69: 14p., NTIS No. AD-711 260.

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0242, MERAMEC PARK LAKE, UPPER MERAMEC RIVER BASIN, MERAMEC RIVER, MISSOURI - UNKNOWN, U.S. Army, Engineer District, St. Louis, Missouri 63120

Abstract: An appendix to the environmental impact study draft for Meramec Park Lake on the Meramec River, contains information on area flooding, water wells, soils, flora and fauna taxonomy, wildlife, and aquaculture.

Publ. Apr. 73: 144p., NTIS No. EIS-MO-73-59.25.

SUPPORTED BY U.S. Dept. of Defense - Army

3.0243, THE EFFECT OF GEOLOGIC STRUCTURE ON THE OCCURRENCE OF FRESH GROUNDWATER IN POST-OLIGOCENE DEPOSITS OF THE GULF COAST PLAIN

P.H. JONES, U.S. Dept. of the Interior, Geological Survey, St. Louis, Missouri

Very large rates of fluid withdrawal from Gulf and petroleum reservoirs (more than 2 billion barrels of water, many millions of GPD of salty water, and billions of barrels of petroleum, and enormous volumes of natural gas) have resulted in widespread large-scale aquifer water salinity changes, and subsidence of fault zones. Effects of oil-field and industrial water disposal through injection wells are unheated, overpressured, low-salinity water in reservoirs freshening progressively with depth. Freshwater is an untapped resource needing intensive study.

To identify, describe, analyze and interpret the features of post-Oligocene deposits of the Gulf

relation of salinity and composition of aquifer waters and the geothermal regime to the sediment facies distribution and geologic structure.

Structural and sediment facies distribution maps will be made using data provided by oil companies, supported by geophysical log cross section. Salinity and composition of aquifer waters will be mapped using chemical analyses of produced waters and electric log-derived salinity data. Isothermal maps will be based upon bottom-hole temperature data recorded on geophysical log headings. Computer processing of salinity, temperature, and sediment facies data will speed map preparation and the analysis and interpretation of the hydrology of the deposits.

Data collection, from oil company records, is still the major effort. Compilation, analysis, and mapping of formation-water salinity and temperature, and computer processing of data have resulted in development of new concepts on deep sedimentary basin hydrology. These, together with the basic data going into computer storage, greatly improve our capability to appraise saline ground-water resources, subsurface environments for waste storage, and geothermal resources.

Continuation of data collection, completion of detailed study and interpretative report on the lower Rio Grande embayment (Text Abridged).

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

3.0244, PREDICTED SAN FERNANDO EARTHQUAKE SPECTRA: GLENDALE AREA

J.R. MURPHY, Environmental Res. Corporation, Las Vegas, Nevada

An analysis of selected aftershocks of the San Fernando earthquake recorded at damage sites in the city of Glendale, California indicates that significant variability in the ground motion spectra occurs within this rather small geographical area. This variability is quantified and used to estimate the main shock ground motion spectra at a number of sites of interest which did not record the main shock.

Pub. Aug. 71: 34p., NTIS No. NVO-1163-TM-30: PC \$3.00 MF \$0.95

SUPPORTED BY No Formal Support Reported

3.0245, SEISMICITY OF THE SOUTHERN NEVADA REGION, DECEMBER 22, 1971 TO JULY 1, 1972

K.C. BAYER, U.S. Dept. of Commerce, Earth Sciences Laboratory, Las Vegas, Nevada 89114

A cooperative network of twenty-three seismic velocity stations is operated in the southern Nevada area, the stations are monitored by the NOAA/ESL Nevada Special Projects Party located in Las Vegas, Nevada. Data from the stations are analyzed and programmed through the Computer Sciences Corporation CDC 6400 Computer, also located in Las Vegas. The most significant and active seismic activity was the Silent Canyon Sequence (areas 19 and 20) on the Nevada Test Site. A map showing the principal earthquake and aftershocks is given and discussed. This is the initial seismic bulletin in which the entire data analysis (including the computer programming) has been accomplished in Las Vegas by the Nevada Special Projects Party. The output is listed in the Hypocenter Summary. The listing is the result of data scaled only from the local network and solutions determined by a local epicenter program. A total of 296 epicenters is listed.

Pub. Jul. 72: 27p., NTIS No. NVO-746-3: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Atomic Energy Commission

K.C. BAYER, U.S. Dept. of Commerce, Earth Sciences Laboratory, Las Vegas, Nevada 89114

A cooperative network of twenty seismic stations in the southern Nevada area, the stations are recorded by NOAA ESL Special Projects Party located in Las Vegas, Nevada. Data from the stations are analyzed by the NOAA Special Projects Party staff, seismic data for the period December 22, 1971 were processed by a CDC 6400 computer. The output is listed in the Hypocenter Summary. The listing includes solutions determined by a local epicenter program and also solutions obtained by the Earthquake Information Center (NEIC). Most of the epicenters are listed. About 250 of these are located within 200 km from Station CPX, which is approximately at the center of the network. Two earthquakes and several of their aftershocks were felt in southern Nevada during 1971. Maps showing the epicenters of earthquakes and their aftershocks are given in the Summary.

Pub. May 72: 41p., NTIS No. NVO-746-1M-3: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Atomic Energy Commission

3.0247, ALUTIAN SEISMIC PROGRAM HYPOCENTER SUMMARY, OCTOBER 1972-APRIL, 1973

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Las Vegas, Nevada

Preliminary data acquired from an Aleutian network of seismic stations are presented. These computations are preliminary and may be revised on the basis of current data. The Aleutian hypocenter summary is a listing of earthquakes located with a network of seismic stations operated by the Branch of Seismic Engineering, U.S. Geological Survey, western Aleutian Islands. The summary lists the geographic coordinates, and depth of each event.

Pub. Jan. 73: 54p., NTIS No. NVO-746-13: PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Atomic Energy Commission

3.0248, DILATANCY AND PREMONITION OF P, S TRAVEL TIMES

I.N. GUPTA, Univ. of Nevada, School of Mines, Reno, Nevada 89507

Abstract: Nur's (1972) explanation of the observed decrease in the travel time ratio of shear (S) to compressional waves $v(P)/v(S)$, in terms of dilatancy is considered. The anisotropic characteristics of dilatancy in the focal region. The expected change in $v(P)/v(S)$ is influenced by the orientation and type of geologic structure. The geometry of source and observation point. The wave will in general split into two components with somewhat different velocities.

Pub. Jan. 73: 7p., NTIS No. AD-775 96(3/2): Reprint \$0.50

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0249, SPECTRAL CHARACTERISTICS AND DROP FOR MICROEARTHQUAKES NEAR FAIRVIEW PEAK, NEVADA

A. RYALL, Univ. of Nevada, School of Mines, Reno, Nevada 89507

Abstract: Frequency and amplitude characteristics for microearthquakes recorded on a local network of component seismographs in the Fairview Peak area.

MAJOR DISASTER TYPES

central Nevada. Maximum trace amplitude of the events decreased with focal distance approximately as R to the minus 1.9 power. Site amplification, by a factor of 2, was observed for the only station not located on rock. Comparison of observed spectra for these events with theoretical spectra given by Brune indicates stress drops ranging from 40 to 600 millibars. Calculated source dimensions and seismic moments for microearthquakes in this area are in agreement with results of earlier studies. When location of the events is considered, the variation in stress drop appears to be related to differences in the faulting mechanisms.

Pub. Sep. 71: 10., NTIS No. AD-738 392: Reprint.

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0250. EARTHQUAKE DISTRIBUTION AND MECHANISM OF FAULTING IN THE RAINBOW MOUNTAIN-DIXIE VALLEY-FAIRVIEW PEAK AREA, CENTRAL NEVADA

A. RYALL, Univ. of Nevada, School of Mines, Reno, Nevada 89507

Abstract: The distribution of microearthquakes in west-central Nevada correlates well with fault-plane solutions for this area and defines a zigzag series of crustal fractures that vary in length from a few to several tens of kilometers. The main Fairview fault strikes northwest, and motion on this fault is right-lateral oblique slip. In other parts of the active zone northeast-striking faults have mainly dip-slip motion. Focal mechanisms are generally consistent with an interpretation of simple block faulting, faults of different orientation having the same slip direction. For the Rainbow Mountain and Fairview Peak areas, crustal blocks to the east of the fracture zone move down and southeast with respect to blocks on the west side. Faulting in this region appears to be related to regional extension, acting in the direction N60W-S60E.

Pub. Jun 71: 9., NTIS No. AD-738 393: Reprint.

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0251. PROBABILITY OF FATIGUE FAILURE UNDER EARTHQUAKE LOADS

J. TANG, Univ. of New Mexico, Bureau of Engineering Research, Albuquerque, New Mexico 87106

Abstract: Whenever a structure is subjected to strong-motion earthquake excitation, certain parts of the structure may undergo plastic deformations which indicate structural damage. It has also been known that the damage due to repeated applications of plastic deformation is cumulative and could cause low-cycle fatigue failures. It is possible for a structure to experience low-cycle fatigue failure under seismic loads. Studies have been made to determine the responses of structures subjected to earthquake excitation.

Pub. Aug 71: 66P., NTIS No. PB-202 553: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

3.0252. A STATISTICAL STUDY OF SOME DESIGN CONCEPTS IN EARTHQUAKE ENGINEERING

P.H. WIRSCHING, Univ. of New Mexico, Bureau of Engineering Research, Albuquerque, New Mexico 87106

Abstract: The results of a study of techniques for improving the safety of seismic structures are presented. In particular, the effect of passive motion-reducing devices on seismic struc-

ture absorber attached to the roof, and a vibrator placed between the ground and the foundation. Various types of devices listed were also investigated. On structural safety, these modified systems are ranked in order of their efficiency as follows: isolator, isolator-absorber-damper, absorber, the damper.

Pub. May 70: 186P., NTIS No. PB-192 693: HC \$0.650

SUPPORTED BY U.S. Natl. Science Foundation

3.0253. ADAPTIVE STRUCTURAL SYSTEMS

J.T. YAO, Univ. of New Mexico, Bureau of Engineering Research, Albuquerque, New Mexico 87106

Abstract: An 'adaptive' structural system is defined as a structural system, the behavior of which varies automatically in accordance with unpredictable variations in the loading conditions and thereby produced desirable response under all possible loading conditions considered. A practical design of an adaptive structural frame is suggested. Many research problems related to the application of the concept of adaptive structural systems are examined.

Pub. Jun 68: 29p., NTIS No. PB-194 014: HC \$3.00

SUPPORTED BY U.S. Natl. Science Foundation

3.0254. SEISMIC DESIGN OF BUILDING STRUCTURES

J.T. YAO, Univ. of New Mexico, Graduate School of Engineering, Albuquerque, New Mexico 87106

Abstract: The purpose of this project was to formulate suggestions for improvements in the design codes concerning building structures which are subjected to earthquake loads. In the process, suggestions were made concerning ways to incorporate new concepts and methods of discrete mechanics, static analysis, as well as earthquake behavior of concrete structures into the seismic design code. Availability of existing design codes is summarized here. Philosophies and methodologies in earthquake engineering were also studied.

Pub. Jul 72: 154p., NTIS No. AD-751 178: PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

3.0255. DYNAMIC BEHAVIOR OF BILINEAR STRUCTURAL SYSTEMS

H.Y. YEH, Univ. of New Mexico, Bureau of Engineering Research, Albuquerque, New Mexico 87106

Abstract: The responses of single-degree-of-freedom and bilinear systems to earthquake excitations are studied using a CSMP (Continuous System Modeling Program). Those results show that the bilinear system is more effective in resisting earthquake loads than corresponding linear systems. Moreover, a type of two-degree-of-freedom system was studied in a similar manner and the results indicate that it can be more advantageous to use the bilinear system.

Pub. Jul 68: 28p., NTIS No. PB-198 372: PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Natl. Science Foundation

3.0256. COMPILATION OF BRITTLE STRAIN MEASUREMENTS WITHIN NEW YORK STATE

Y.W. ISACHSEN, State Dept. of Education, Albany, New York 12242

Current plans and/or progress. This project should be completed during the course of 1974, incorporating much new linear data from ERTS-1 imagery.

SUPPORTED BY No Formal Support Reported

3.0257, LARGE SCALE INTEGRATION IN URBAN PLANNING WITH APPLICATIONS TO TALL BUILDING PLANNING IN REGIONS SUBJECTED TO NATURAL HAZARDS

B.G. JONES, Cornell University, School of Architecture, Ithaca, New York 14850

This study will attempt to make strides in the improvement of methodology for the spatial planning of regions which are subjected to periodic disasters resulting in extensive reconstruction or construction of the region. Experience has shown that the construction following a natural disaster often includes new high-rise structures. Of interest is development of methodology which will be of use in establishing the consequences of including high-rise structures in the plan for the development of a region in the reconstruction and next period following a disaster. The method to be used involves the use of time series data allowing the recording of the trace of the development path and will allow the comparison of the socio-economic structure with selected comparable regions. Mid-range development objectives will be developed that seem appropriate and realizable in terms of the previous pace of development and levels achieved in comparable nearby regions. The methodology will be tested using data derived from the Banja Luka region of Bosnia, Yugoslavia, which was devastated by an earthquake in 1969.

SUPPORTED BY U.S. Natl. Science Foundation

3.0258, MICROSEISMICITY AND TECTONICS OF THE NEVADA SEISMIC ZONE

F.J. GUMPER, Columbia University, Lamont-Doherty Geol. Observ., Palisades, New York 10964

Abstract: Microseismicity, composite focal-mechanism solutions, and previously-published focal parameter data are used to determine the current tectonic activity of the prominent zone of seismicity in western Nevada and eastern California, termed the Nevada Seismic Zone. The microseismicity substantially agrees with the historic seismicity and delineates a narrow, major zone of activity that extends from Owens Valley, California, north, past Dixie Valley, Nevada. Focal parameters indicate that a regional pattern of NW-SE tension exists for the western Basin and Range and is now producing crustal extension within the Nevada Seismic Zone.

Pb. Nov. 71: 26p., NTIS No. AD-737 576. Reprint.

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0259, MEASUREMENTS FOR FAULT SLIP ON THE DENALI, FAIRWEATHER, AND CASTLE MOUNTAIN FAULTS, ALASKA

R. PAGE, Columbia University, Lamont-Doherty Geol. Observ., Palisades, New York 10964

Abstract: Geodetic networks with dimensions on the order of 40 meters to 2 km were established across the Denali, Fairweather, and Castle Mountain faults to measure slip by repeated annual triangulation. Within the resolution of the data, slip was not observed on any of the faults; specifically, horizontal and vertical slip, if not zero, was less than 3 mm on the Denali and Fairweather faults for 1967-1969 and 1968-1969, respectively, and less than 5 mm on the Castle Mountain fault for 1966-1969. The Denali and Fairweather faults are considered to be active, but the Castle Mountain fault is considered to be inactive.

Pb. Sep. 71: 11p., NTIS No. AD-737 576. Reprint.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

3.0260, EXPERIMENTAL AND THEORETICAL STUDY OF THE DILATANCY-DIFFUSION MODEL FOR EARTHQUAKE PREDICTION

C.H. SCHOLZ, Columbia University, Lamont-Doherty Geol. Observ., Palisades, New York 10964

This is an extensive experimental and theoretical program directed at the goal of developing a quantitative model of dilatancy and fluid flow for the prediction of earthquakes.

The work will involve laboratory studies of dilatancy at pressure and temperature conditions appropriate to the upper part of the earth's crust, emphasizing detailed measurements of v_p and v_s , strains, stresses, pore pressure, and permeability. Combined with the laboratory work will be theoretical studies directed toward developing a quantitative theoretical model of dilatancy and fluid flow to utilize the experimental results and to extend it to earthquake prediction. This work will be interfaced with other work being done at Lamont-Doherty on observational studies of dilatancy prior to earthquakes, such as at Blue Mountain Lake, New York.

Five main phases of work are proposed: (1) Laboratory verification of the dilatancy-fluid flow model for earthquake prediction; (2) Basic research into dilatancy and, in particular, the problems inherent in the present formulation of the model; (3) Development of a theoretical model; (4) Laboratory measurements of the parameters and processes necessary for quantitative application of the model and (5) Application of the above results to observational data for earthquake prediction as such data become available.

SUPPORTED BY U.S. Natl. Science Foundation

3.0261, SEISMOLOGY AND GLOBAL TECTONICS: A STUDY OF SEISMICITY GAPS AND INTRAPLATE EARTHQUAKES

L.R. SYKES, Columbia University, Lamont-Doherty Geol. Observ., Palisades, New York 10964

The hypothesis of global tectonics in the next few years will have an important impact on studies of earthquake prediction and of intraplate tectonics. A careful program of research directed toward increased fundamental understanding of short-term interactions of lithospheric plates and of evidence from intra-plate tectonics that bears upon the driving mechanism of plate tectonics will be conducted. This increased understanding will be sought by studies of seismicity gaps, regularities in the accumulation and release of seismic energy along major plate boundaries, changes in seismic activity before large earthquakes, intra-plate earthquakes, and patterns of stress distribution within plates as inferred from focal mechanisms and in situ stress measurements. It is also planned to study the precise distribution of large earthquakes and their aftershocks in time and space along several of the major oceanic transform faults. Since these oceanic tectonic zones are relatively simple and straight, they offer one of the best opportunities to find regularities in stress propagation along plate boundaries. This work may provide insights for estimating seismic risk for areas like California where the tectonic pattern is also of the transform-fault type.

SUPPORTED BY U.S. Natl. Science Foundation

3.0262, A COMPREHENSIVE STUDY OF THE SEISMOTECTONICS OF THE ALUTIIAN ARC, ALASKA

L.R. SYKES, Columbia University, Lamont-Doherty Geol. Observ., Palisades, New York 10964

Island Arc and to evaluate the earthquake risk in that region. The tectonics of the Aleutian arc is investigated within the framework of recent advances in plate tectonics. Research on seismology is emphasized, but information from geology, geodesy, volcanology, geochemistry and marine geology is also considered. Focal mechanism solutions of earthquakes provide information on the pattern of tectonic stresses and relative motion of tectonic blocks. The spatial distribution of earthquakes outline the plate boundaries and the deep earthquakes indicate that the Pacific plate is being underthrust beneath the Bering Sea - Alaska plate to a depth of at most 250 km. Travel times of seismic body waves and dispersion of surface waves show strongly anomalous upper mantle velocities associated with the island arc structure. The study of the historic and recent seismic record allows us to identify zones of high seismic risk for future large and destructive earthquakes. Two telemetered seismic networks are operated. Seismic information from these networks are analyzed to evaluate the possibilities for earthquake prediction in zones of high seismic risk. This study has important implications for understanding risks from volcanoes and seismic sea waves (tsunamis).

Results: Operation of 3 seismic stations and 2 telemetered seismic arrays in the Aleutians and Alaska Peninsula. Identification of four zones with high risk for future major earthquakes, one of which has proved to be correctly predicted. Quantitative determination of anomalous seismic-wave velocities in the upper mantle associated with typical island arc structures such as the downgoing slab of Pacific lithosphere and the Island Arc Ridge. Installation of 3 strong-motion seismic accelerometers. Geodetic dry-tilt sites and experimental installation of tiltscopes monitor long-term tectonic deformation of the earth's crust.

SUPPORTED BY U.S. Atomic Energy Commission

3.0263, TECTONIC STRESS IN THE EASTERN U.S. BY SEISMIC METHODS

M. WYSS, Columbia University, Lamont-Doherty Geol. Observ., Palisades, New York 10964 (14-08-0001-12289)

Detailed study of the focal mechanism and source parameters of specific earthquakes and their aftershock sequence for the purpose of determining in-situ stress by seismic means. Primary emphasis will be placed on determining stress maps for the Eastern U.S. But as far as possible, a stress map will be developed for the entire U.S. by integrating early results for the Western U.S. Stress calculations will be compared with in-situ stress measurements at Denver Arsenal and Ringely Oil Field.

Using seismological data from existing stations, the seismic moment, total recorded energy, and the corner frequency will be measured. These parameters will be used to calculate estimates of source dimensions, amount of fault slip, stress drop, and a lower bound on the total stress in the source region.

Supporting agency address information: Defense Advanced Research Projects Agency, Arlington, Va. 22209

SUPPORTED BY U.S. Dept. of Defense - D.A.R.P.A.

3.0264, AGE, GEOMETRY, AND STRESS FIELDS OF FOUR MAJOR FAULTS OF THE CALIFORNIA TRANSVERSE RANGES BY EVALUATION OF WELL DATA

R.S. YEATS, Ohio University, School of Arts, Athens, Ohio 45701

principally on subsurface well data obtained in the search for, and the production of oil and gas. The region underwent virtually continuous sedimentation during and following the imposition of the north-south compressional stress field that dominates it today. Over 1,000 well logs are being used in the study, providing the opportunity for three-dimensional analysis unique in the Transverse Ranges; other information concerning anomalous fluid pressures, nonplanar oil-water interfaces, and geothermal gradients are also being used. The first year of the study concentrated on the Oak Ridge high-angle-reverse fault.

The investigation will be extended to the Red Mountain, San Cayetano, and Santa Susana faults and the tectonically over-pressured Ventura Avenue anticline. After cross-sections and contour maps are constructed for these individual structures, regional stress trajectory cross sections and maps showing displacement vectors and strain rate changes parallel to strike will be constructed (using computer analysis and display; this is expected to shed light on fundamental problems of the mechanics of thrust faulting in a seismically active region).

SUPPORTED BY U.S. Natl. Science Foundation

3.0265, SURVEY REPORT ON STRUCTURAL DESIGN OF PIPING SYSTEMS AND COMPONENTS

E.C. RODABAUGH, Battelle Memorial Institute, Columbus, Ohio 43201

A summary of design practices, service experience, and research work on the structural design of piping components and systems is presented to provide a background and direction for future work. The analysis is restricted to structural design aspects of metal piping systems. The information is presented in chapters on factors involved in structural design, analytical methods, failures, standards, straight pipe welds, curved pipes and miters, connections, reducers, valves and pumps, supporting elements, thermal stresses, and dynamic effects.

Pub. Dec. 70: 561p., NTIS No. TID-25553; PC \$6.00 MF \$0.95.

SUPPORTED BY U.S. Atomic Energy Commission

3.0266, SEISMICITY INVESTIGATIONS IN THE CASCADE MOUNTAINS AND VICINITY, OREGON, 1 MAY 1969 - 30 APRIL 1970

H.R. BLANK, Univ. of Oregon, School of Liberal Arts, Eugene, Oregon 97401

A study is reported of seismicity in the Cascade Mountains and vicinity, Oregon, a Cenozoic volcanic region of diverse structural and lithologic aspects which offers an array of terrestrial analogs to lunar and planetary volcanic terrains. Specific objectives of the program included 1) installation and operation of a seismic station at the suitable site on Pine Mountain in central Oregon; 2) design and fabrication of an ultra portable seismic system for the detection of microearthquakes; 3) determination of absolute and relative seismicities of major Cascade volcanoes by means of reconnaissance microearthquake surveys and 4) comparison of seismicity levels in the High Cascades with seismicity levels in adjacent volcanic provinces.

Pub. Jul 70: 32p., NTIS No. N70-32970; HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

3.0268.

Abstract: Presents information on the geology of the project area. Gives information on reservoir slope stability, seismicity, and possible effects of earthquakes on the reservoir.

Pub. Oct. 72. 12p., NTIS No. EIS-OR-72-4666-E-S. PC \$3.00 MF \$0.95.

SUPPORTED BY: U.S. Dept. of Defense - Army

3.0268, SEISMIC HAZARD REGIONALIZATION AND PROBABILITY OF FUTURE EARTHQUAKES IN THE UNITED STATES

B.F. HOWELL, Penn State University, School of Earth Sciences, University Park, Pennsylvania 16802

The past history of earthquakes of intensity V and larger, in North America between 30 degrees 50 degrees N latitude will be studied to evaluate to what degree the past history can be used to predict the future hazard from earthquakes. A pilot experiment using only 88 moderate and large earthquakes in the eastern half of the area suggests that past occurrences fail to delineate clearly the relative hazard for areas less than 10 degrees on a side.

Using procedures developed in the pilot experiment, evaluations will be made of the precision to which the seismic hazard can be estimated in areas 1 degree, 2 degrees, 4 degrees, 5 degrees, and 10 degrees on a side. These will be based on: A, the extent to which large earthquakes tend to occur in areas where small earthquakes are also common; B, the degree to which there have been small earthquakes previous to the largest earthquake in an area; and C, the correlation of the spatial occurrence of events on odd dates with those on even dates. Allowance will be made for different attenuation of intensity with distance from the epicenter in the eastern and western parts of North America.

Based on these studies, maps of relative hazard for the region will be prepared using a quantitative measure of the expected hazard, subdividing the country into regions of similar tectonic characteristics.

The probability that the locus of most probable seismic risk tends to move about, causing a temporary decrease in hazard after a very large earthquake, will be tested.

SUPPORTED BY: U.S. Natl. Science Foundation

3.0269, EARTHQUAKE RISK EVALUATION - CRITTENDEN COUNTY, ARKANSAS, DESOTO COUNTY, MISSISSIPPI, AND SHELBY COUNTY, TENNESSEE

F. KELLOGG, Mississippi Ark. Tenn. Council, Memphis, Tennessee

Abstract: This report summarizes progress in a study of the earthquake risk in Crittenden County, Arkansas, DeSoto County, Mississippi, and Shelby County, Tennessee. The study is designed to set up a decision model usable by officials in this and other areas for the purpose of adopting building code policies furnishing appropriate earthquake protection where damage could be great but frequency of damage is small. The geological conditions and physical properties of rocks and soils germane to this objective are presented, construction has been classified according to use, height, design and foundation type and dollar volumes for the area have been estimated for the years 1970, 1980, 1995, and 2020. Desirable additional work has been indicated.

Pub. May 73. 121p., NTIS No. PB-223 087/8. PC \$8.25 MF \$1.45.

UNKNOWN, Mississippi Ark. Tenn. Council, Memphis, Tennessee

Abstract: The report covers the development to date of basic parameters required to evaluate the earthquake risk of the MATCOG area. Consideration has been given to the seismic history and the geotectonics of the Missouri, Arkansas, Kentucky, Tennessee, Mississippi area. Earthquake motion data from California and other U.S. areas were assembled, evaluated and summarized for applicability to the central United States. A methodology is included for the attenuation of earthquake intensity with distance, determination on damages experienced in quakes of different intensities and the insurance industry practices are reviewed pertinent to the making of future damage estimates.

Pub. May 73. 190p., NTIS No. PB-223 186/8. PC \$11.50 MF \$1.95.

SUPPORTED BY: No Formal Support Reported

3.0271, DYNOR - DYNAMIC ANALYSIS OF STRUCTURAL SYSTEMS

R.M. HOLMES, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830

Dynor is a computer program that was developed to analyze the response of structural systems to the vibratory ground motion of earthquakes as well as sinusoidal motion. This program can be applied to structural systems that can be mathematically idealized with beam-type elements which have no more than three degrees of freedom per joint. The input for the earthquake vibratory motion may be either time history or response-spectrum data. The program is written in FORTRAN IV language, and it is operable on the IBM 1600 computer at Oak Ridge National Laboratory. The supporting theory and procedures are described and detailed instructions for the use of DYNOR are presented herein.

Pub. Jul. 73. 89p., NTIS No. ORNL-TM-4275. PC \$6.50 MF \$1.45.

SUPPORTED BY: U.S. Atomic Energy Commission

3.0272, EARTHQUAKES INDUCED BY UNDERGROUND FLUID INJECTION

B.C. MCGLOTHLIN, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830

In 1966, an unusual series of earthquakes near Denver, Colorado were correlated with deep well waste disposal operations at the Rocky Mountain Arsenal. Since that time, additional investigations have confirmed the postulated cause-and-effect relationship and have established the mechanisms responsible. Because of this experience, various questions have been raised about the possibility of a similar occurrence related to ORNL's hydraulic fracturing waste disposal practices. The mechanisms of the Denver earthquake sequence are examined in detail and the conditions necessary for such a phenomena determined. These conditions are so stringent that only in very rare occasions are they approached in normal industrial or oil field deep well disposal operations. By applying these necessary conditions to the situation existing in the Oak Ridge site, it can be unequivocally demonstrated that hydraulic fracturing operations cannot result in earthquakes by the mechanism responsible at Denver.

Pub. Oct. 70. 17p., NTIS No. ORNL-TM-315-1. PC \$3.00 MF \$0.95.

This research will be an experimental investigation of the influence of shape and embedment on the dynamic response of foundation - soil systems. Circular and noncircular (rectangular) model footings will be used which will be cast-in-place concrete footings. Transient vertical, torsional, and rocking and sliding motions of these footings will be studied for surface and embedded models. From the surface investigation, equivalency factors relating the response of noncircular footings to the response of circular footings will be determined in all three modes of vibration. The embedded model investigation will be conducted with footings of the same size as those used in the surface investigation but with varying depths of embedment. The embedded models will be tested initially as cast-in-place footings, next with the soil compacted along the embedded depth removed, and finally with backfill placed around them. In this manner, the influence of embedment on the response of circular and noncircular footings in all three modes of vibration will be evaluated. These results will be of value in predicting the response of foundations to dynamic loads and in analyzing the response of structures to seismic disturbances.

SUPPORTED BY U.S. Natl. Science Foundation

3.0274. THE EFFECT OF YIELD STRENGTH AND DUCTILITY TO FATIGUE DAMAGE

H.Y. YEH, Texas A & M University System, School of Engineering, Prairie View, Texas 77445

Abstract: The cumulative damage of aluminum alloys with different yield strength and various ductility due to seismic loads was studied. The responses of an idealized beam with a centered mass at one end and fixed at the other end to El Centro's and Taft's earthquakes are computed by assuming that the alloys are perfectly elastoplastic materials and by using numerical technique. Consequently, the corresponding residual plastic strain can be obtained from the stress-strain relationship. The revised Palmgren-Miner cumulative damage theorem is utilized to calculate the fatigue damage. The numerical results show that in certain cases, the high ductility materials are more resistant to seismic loads than the high yield strength materials. The results also show that if a structure collapses during the earthquake, the collapse always occurs in the very early stage.

Pub. Feb. 73. 36p., NTIS No. N73-26916/9; PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Natl. Aeron. & Space Admin.

3.0275. SEISMICITY AND CONTEMPORARY TECTONICS OF THE YELLOWSTONE PARK-HELGES LAKES REGION

R.B. SMITH, Univ. of Utah, School of Mines, Salt Lake City, Utah 84112

Abstract: In order to relate the seismic activity of the Yellowstone Park-Helges Lake area to the regional tectonics, detailed microearthquake monitoring was undertaken during the summer of 1972 to identify the local seismic patterns, and to determine the local stress distribution from fault plane solutions. Also a study of the possible correlation of earthquake swarms to geothermal features was conducted in the Norris Geyser Basin and in the Upper and Lower Geyser Basins.

Pub. May 73. 76p., NTIS No. COM-74-10591/7; PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.

S.H. WARD, Univ. of Utah, School of Mines, Salt Lake City, Utah 84112

The proposed research is to study the regional seismotectonics of the southern Intermountain Seismic Belt with emphasis on the Wasatch Front. To study the seismicity, new high-gain stations would be added to the regional network in Utah by removing ten vertical seismometer stations from the Uinta Basin Seismological Observatory (UBSO) and re-installing them along the Wasatch fault zone and seismically active fault zones (Sevier-Tushar, East of Hurricane) in Utah along the southern Intermountain Belt. This improved network would permit (1) determination of hypocenters, (2) an enhancement of mechanism investigations, (3) array analysis for rupture, (4) improvement in earthquake prediction and (5) better correlation with strain and tilt data obtained from the Granite Mountain Records Vault (GMU). The seismicity would be telemetered along telephone lines and linked to the University of Utah campus in Salt Lake City.

SUPPORTED BY U.S. Natl. Science Foundation

3.0277. SEISMICITY STUDIES OF THE CENTRAL APPALACHIAN REGION

G.A. BOLLINGER, Virginia Polytechnic Institute, Blacksburg, Virginia 24061

The objective of the proposed research is to continue studies in the Appalachian seismic zone and to obtain data and results generated to the geology and tectonics of the region. Focal depths and focal mechanism solutions correlatable with regional geology and tectonics, needed in the Appalachian region. In addition to the extremely fundamental relation of seismicity data to geological sciences, the population density of the region warrants a much more detailed description of seismicity and characteristics than currently exists.

Three additional studies have been shown by the work published thus far to be necessary for continued studies. These studies are: (1) Development of a local magnitude based on the 1-g phase in the Southeastern States, (2) micro-earthquake studies of aftershock sequences, the spatial and temporal patterns in the Appalachian regime, (3) Determination of the upper crustal seismic velocities and propagation characteristics.

SUPPORTED BY U.S. Natl. Science Foundation

3.0278. SOIL BEHAVIOR UNDER EARTHQUAKE LOADING CONDITIONS

UNKNOWN, Shannon & Wilson Incorporated, Washington

No summary has been provided to the Smithsonian Information Exchange.

Pub. Jan. 72. 394p., NTIS No. HD-25953; PC \$10.00 MF \$0.95.

SUPPORTED BY U.S. Atomic Energy Commission

3.0279. DYNAMIC STABILITY OF EARTH STRUCTURES

R.C. BOSTROM, Univ. of Washington, School of Architecture, Washington 98105

This program is being undertaken to investigate the properties of soils and soil liquefaction. Special emphasis will be given to the interpretation of dynamic soils tests which involve the determination of the planar as well as the variations of accelerations in a soil mass compared to the undisturbed state.

3.0280.

tion characteristics of both granular solid (at different densities) and cohesive soils (at several moisture contents).

Studies will be undertaken for both deterministic and random excitations

SUPPORTED BY U.S. Natl. Science Foundation

3.0280, A STUDY OF SEISMICITY AND CRUSTAL STRUCTURE IN WESTERN WASHINGTON USING A SEISMIC TELEMETRY NETWORK

R.S. CROSSON, Univ. of Washington, School of Arts, Seattle, Washington 98105

Seismicity in the Puget Sound region of western Washington has been under investigation using a seismic telemetry array since mid-1969. Earthquakes as small as magnitude 1 can be located in the southern part of the basin and a definite pattern of hypocenters has emerged during a one-year observation period. Initial analysis indicates that the upper mantle velocity is low, at 7.8 km/sec. Most foci are between 15 and 30 km in depth. The Cascade range is seismically active along its west margin, but exhibits little seismicity in its core.

The focal mechanisms of local earthquakes are consistent with N-S compression. Work is in progress on a method of inverting for crustal structure using local earthquake data, on the study of P wave travel time, amplitude and frequency anomalies, and on the study of crust and mantle velocities from regional earthquakes recorded with the array.

Research on seismicity and structure, and their accompanying tectonic implications will be extended by the addition of 2 stations to the present array in the critical region to the north.

SUPPORTED BY U.S. Natl. Science Foundation

3.0281, BUILDING STANDARDS AND THE EARTHQUAKE HAZARD FOR THE PUGET SOUND BASIN

B. GONEN, Univ. of Washington, School of Engineering, Seattle, Washington 98105

This report presents a historical record of the character and the effects on structures of the two most recent major earthquakes (1949 and 1965) in the Puget Sound area, outlines the history and current state of building-code provisions for earthquakes in the Puget Sound area, and discusses possible regional activities that could aid materially in reducing damage during future earthquakes in the Puget Sound region. The aim of this report is to provide a reference source of regional information relevant for earthquake-resistant buildings in the Puget Sound Basin. Since structural effects cannot be dissociated from ground effects, this study briefly examines soil, geological and seismological effects for the Basin.

The 1949 earthquake is discussed in Chapter 2 and the 1965 earthquake in Chapter 3. The history of building codes and changes in building-code ordinances for earthquake design within the Puget Sound region for the period from 1946 through 1973 are reviewed in Chapter 4. The future for earthquake resistant design is discussed in Chapter 5.

This program will study the strength and behavior of slab-to-column and slab-to-wall connections under seismic loading. Tests will be made on specimens representative of connections to both interior and exterior columns and walls. They will be subjected to statically applied, reversed cyclic loadings having increasing ductility demands. The tests will be conducted in three stages. In the first stage the reinforcement details necessary to ensure ductility and the maintenance of adequate ultimate capacity will be determined for connections to square interior columns. In the second stage these details will be determined for columns with rectangularities approaching those for walls and for specimens simulating both interior and exterior connections. In the third stage the effects of co-existing in-plane shear forces will be examined. An analytic program will support the experimental activity. Once the moment-rotation characteristics for different types of connections at different locations are obtained experimentally, available finite element computer programs will be used to determine the theoretical responses under seismic loading of typical structures incorporating flat plate framing either acting alone or in combination with shear walls.

SUPPORTED BY U.S. Natl. Science Foundation

3.0283, SEISMIC ACTIVITY OF THE CASCADE VOLCANOES

S.B. SMITH, Univ. of Washington, School of Arts, Seattle, Washington 98105

Earthquakes directly associated with volcanoes are several basic types. One type is indistinguishable from ordinary tectonic earthquakes produced by faulting. These are usually scattered around the volcano with focal depths of 1-20 kilometers. A second type is the volcanic, or type 'B' earthquake which is usually located at a shallow depth near the volcano's summit. The envelope of such an event consists of an emergent arrival and a more gradual decrease in amplitude. The mechanism for these events has never been adequately explained. Both of these types of volcanic earthquakes have been observed on several volcanoes in the Cascade Mountains of Washington. A seismic array will be deployed high on Mt. St. Helens and/or Mt. Rainier to record type B events near their source in order that their mechanism can be studied and better understood.

SUPPORTED BY U.S. Natl. Science Foundation

3.0284, DEMONSTRATION OF A TECHNIQUE FOR LIMITING THE SUBSIDENCE OF LAND OVER ABANDONED MINES ROCK SPRINGS, WYOMING

UNKNOWN, Unknown Inst. at Injuly, Grant, Wyoming

This report provides guidance to community planners and decision-makers facing subsidence problems over abandoned mines. It is based upon the findings, results, and conclusions of the demonstration project carried out by the City of Rock Springs, Wyoming in October 1970. The aims of the project were: Demonstrate the feasibility of backfilling underground mine voids for the prevention and alleviation of surface subsidence by a process developed by Dowell, a division of Dav

4. EXPANSIVE SOILS

DISASTER MITIGATION

4.0001. URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORD, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, loss of mineral resources to urbanization, landsliding, flooding, erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of possible loss-reduction measures, and agencies responsible for those measures.

Pub. Jun 73: 114p., NTIS No. PB-222 447/5. PC \$7.75 MF 1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

4.0002. INFLUENCE OF NEGATIVE PORE PRESSURE DEVELOPMENT IN EXPANSIVE CLAYS ON DAMAGE TO MILITARY FACILITIES (ABBREV)

L.D. JOHNSON, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

To determine the influence of negative pore pressure in desiccated clay soils on subsoil volume changes which adversely affect the behavior of building foundations in swelling clay soils. This study is relevant to maintenance and operation of military structures founded on expansive clays.

Equipment will be designed and constructed for the measurement of negative pore water pressure in partly saturated soils under simulated in situ overburden pressures. The negative pore water pressures of selected expansive clays will be determined by the pressure plate technique to evaluate the heave characteristics of foundation soils.

Supporting agency address information: OCE Waterways Experiment Station, Vicksburg, MI. 39180

SUPPORTED BY U.S. Dept. of Defense - Army

4.0003. REVIEW OF LITERATURE ON EXPANSIVE CLAY SOILS

L.D. JOHNSON, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: Differential heave from moisture absorption of expansive clay foundation subsoils has been the source of considerable damage to numerous man-made structures around the world. The amount of heave actually observed is dependent on many factors, particularly climatic conditions, moisture content of the soil immediately prior to placement of the structure, and amount and type of the foundation clay. The most expansive types of soil are those that contain calcium and, especially, sodium montmorillonite minerals. The

face tension forces and occurs only in partially saturated soils. The procedure for construction on expansive foundation subsoils begins with a design study of the site to determine the characteristics of the soil. Once these are known, the soil can be stabilized to minimize foundation heave or, if this proves impractical, the structure can be designed to withstand the expected heave.

Pub. Jun 69: 59p., NTIS No. AD-709 583: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Army

HAZARD REDUCTION

4.0004. GEOLOGY OF THE RAPID CITY AREA, SOUTH DAKOTA

J.M. CATTERMOLE, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: South Dakota.

The Rapid City project is a general geology and engineering geology study of a rapidly growing urban area. Three quadrangles, Rapid City West, Rapid City East, and Rapid City NW, have been mapped geologically at a scale of 1:24,000. The maps of the Rapid City West and Rapid City East have been published in the Geologic Quadrangle Map Series in full color with a columnar section and text; the map of the Rapid City NW quadrangle was scheduled to be printed in 1973 and should be released early in 1974.

The final product of the project is a two part Bulletin covering the entire urban area of Rapid City: the first part will describe the geology, structure and stratigraphy of the three quadrangles; the second part will detail foundation conditions, expansive soils, construction materials, landslides, and physical characteristics of each formation and the pertinent effects related to planning engineering projects.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

4.0005. DENVER URBAN CORRIDOR STUDIES - COLORADO

W.R. HANSEN, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

Project intends to derive maximum possible geotechnical information from existing available data, supplemented by areal, engineering geologic, hydrogeologic, geochemical, and geophysical studies. Geotechnical maps will be prepared at scales ranging from 1:125,000 to 1:24,000. Project covers virtually all the rapidly urbanizing area at the foot of the Front Range, and the rural areas between, from Fort Collins on the north to Colorado Springs on the south - a distance of about 120 miles, in a belt 40 miles wide extending from the foothills east across the Colorado piedmont. This is one of the fastest growing regions in the Nation. It contains a broad spectrum of geotechnical problems, such as swelling and subsiding foundation soils related to clayey and loessial substrates, declining artesian water pressures, shallow and rising water tables, increasing urban runoff, surface- and ground-water pollution, unstable slopes (landslides), declining gravel resources, urban sprawl across varied geologic terranes, solid waste disposal problems, and general environmental degradation.

The Juneau project started as part of a binational communities program of earthquake hazard studies following the March 1964 Alaska earthquake. The original primary objective was to investigate and evaluate potential hazards from earthquakes as a result of the geologic setting. The study has been broadened to include other natural geologic events and to try and relate man's use of the land to the existing geologic environmental conditions. Field mapping was completed in 1971.

The project consists of differentiating and mapping surficial deposits and performing physical properties tests on selected samples. Development of raised marine and glaciomarine deposits, glaciofluvial, glacial, and lacustrine deposits is coupled to the geologic history, which in part influences the different physical properties inherent in the materials. The availability and utilization of this information can help the planning and execution of urban expansion and industrial development to hopefully avoid geologic pitfalls by taking into account the geologic influence on the environment, such as relative stability of deposits in case of severe earthquakes, areas of known or potential rockfalls and avalanches, and differing foundation conditions.

A geologic map with text and interpretive transparent overlays was released to open file in May 1972. A U.S. Geological Survey Bulletin, 1394-C, was published in 1973 that gave the glaciomarine deposits a formation name, the Gastineau Channel Formation. A geologic map with tabular text is being processed for publication in the Miscellaneous Geologic Investigations Map series of the Geological Survey.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

4.0007, STABILIZATION OF EXPANSIVE CLAYS AND SHALES

R.D. RICHMOND, U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado 80225

More knowledge is needed of treatments and construction procedures to economically stabilize expansive soils and soft rock to prevent damage to overlying structures. Various methods such as replacement or treatment with lime are available; however, these are costly and not practicable for deep foundations. The need for new methods was recently emphasized by a matrix team which investigated the damage from differential heaving at Fort Thompson Substation location on Pierre shale in South Dakota.

A review of pertinent investigations by others was completed. Various chemicals and stabilizers such as lime are being investigated in the laboratory. Promising methods in the laboratory can then be tried on a field scale.

Laboratory tests are in progress on lime-clay mixtures to evaluate (1) the effect of temperature changes on curing time and (2) the effect of curing time on the desiccation of stabilized soils under field conditions.

Laboratory and field tests are also planned for in situ shales utilizing electro chemical stabilizers

SUPPORTED BY U.S. Dept. of Interior - Bn. Reclamation

4.0008, UNIVERSITY-INDUSTRY WORKSHOP ON HAZARDS AND DAMAGE RELATED TO EXPANSIVE EARTH MATERIALS

D. RICHARD, Univ. of Denver, Graduate School, Denver, Colorado 80210

This workshop will attempt to summarize the state-of-the-art and critical areas needing research in the field of expansive

materials at 2 billion dollars per year in a recent Civil Engineering Magazine article.

The workshop will consist of general discussions and five specific areas of interest as follows: 1. Pavements - highways, roads, streets, airports and parking facilities. 2. Light Buildings - residential buildings, schools, light commercial buildings, etc. 3. Heavy Buildings - single and multistory industrial and commercial buildings, power and pumping plants, etc. 4. Other Facilities Problems - buried utilities, canals, large pipelines, dams, landslides, etc. 5. Organization, planning and financing for accomplishing general objectives, as related to Workshop findings. Coordination, liaison and technical input to assigned groups.

SUPPORTED BY U.S. Natl. Science Foundation

4.0009, MAPPING OF SURFACE MATERIALS FOR PREDICTING FOUNDATION CHARACTERISTICS IN FUTURE DEVELOPMENT OF HATTIESBURG

B.H. BROWN, Univ. of Southern Mississippi, School of Science, Hattiesburg, Mississippi 39401

An evaluation of shallow surface materials and x-ray identification of clay minerals present in order to delineate areas where expanding type clays create foundation problems

SUPPORTED BY University of Southern Miss. - Hattiesburg

5. FOREST & GRASS FIRES

PUBLIC ASSISTANCE

5.0001, PROFILING THE FOREST INCENDIARIST: AN ANALYSIS OF DOCUMENTED CASE HISTORIES

J.E. DUNKELBERGER, Auburn University, Agricultural Experiment Sta., Auburn, Alabama 36830 (AI A-01-00491)

Objective: Describe personal and social characteristics of selected persons against whom fire trespass cases were initiated by U. S. Forest Service, Region 8, 1960-72; compare characteristics of incendiaries with those of other fire trespassers against whom cases were initiated during same period; develop guidelines for identifying and deterring the actions of potential fire starters

Approach: Information to be obtained from "Fire Trespass Reports" (U.S.F.S., Forms 5100-29, 5300-1, and 5300-21 filed during the years 1960-72 involving fires in national forests in Ala., Ga., La., Miss., S. Car., and Tenn.); and interviews with local fire investigators. Malicious incendiary cases will be reviewed and analyzed. Between 75-100 cases are anticipated. A comparable number of non-incendiary (accidental) cases from each geographic area and year will be obtained. Because of large numbers of non-incendiary cases in relation to incendiary cases, minimal information (name, occupation, address and reputation) about the offender will be obtained for a random 50% sample. Data will be analyzed quantitatively for different types of cases and qualitatively as case studies.

Progress: Data for Alabama, Mississippi, Georgia, Tennessee, Louisiana and South Carolina over a period of years have been collected with some exceptions. In total 74 individuals have been identified as involved in malicious woods burning. Information from U.S. Forest Service forms has been obtained on forest fires. Other sources of information provided information on characteristics of fire setters. Observations

who are known to or are believed to have set fire to forests. Data are being organized, classified, and analyzed.

SUPPORTED BY Alabama State Government - Montgomery

5.0002, PRESCRIBED FIRE TECHNOLOGY FOR THE SOUTHWEST

A.W. LINDENMUTH, Northern Ariz. University, U.S.D.A. Rky. Mtn. Forest Sta., Flagstaff, Arizona 86003 (RM2102)

Objective: Determine fire intensities that will accomplish management objectives, and develop prescriptions for fires that will attain the desired intensity.

Approach: Determine the natural characteristics and conditions of fuels that influence fire intensity, and how much. Determine what fuel modification treatments are required to alter natural characteristics and conditions of fuel and thereby possibly alter fire intensity. Determine the characteristics and conditions of weather and topography that influence fire intensity, and how much. Determine patterns of ignition that influence fire intensity under different combinations of fuel characteristics, conditions and winds. Determine fire intensities that are effective for doing specific jobs. Determine operational systems for using fire efficiently for doing specific jobs.

Progress: Fuel Chemistry: A chemical coefficient based on phosphate content of leaves has been built into the Arizona oak-chaparral fire spread model. The multiplying factor can increase spread estimates by more than 250 percent, and is in close agreement with both laboratory and field experimental data. Spatial and chronologic sampling oak foliage shows a notable sine wave relationship between phosphate content, leaf age, and physiological condition. Leaf age dates from beginning of the flush of new leaf growth which may come anytime from early April until late August, and in rare years not at all. Variations in foliar phosphate content appear to be caused primarily by translocation within plants. A predicting model is underway. Evergreen Brush Combustion: Conceptual and stochastic fire spread models available do not operate satisfactorily in Arizona oak-chaparral. A new statistical model has been developed directly from research fire data and accounts for more than 80 percent of variation in rate of spread of research fires. The model has been compared with data from larger research fires with satisfactory results. As rate of spread is not an adequate index of fire behavior for management, statistical models for fire intensity, fuel consumption, flame characteristics, fuel temperature, and fuel moisture are being processed for operational use.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0003, PHYSICAL CHARACTERISTICS OF CHAMISE AS A WILDLAND FUEL - CALIFORNIA

C.M. COUNTRYMAN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: Chamise shrubs in southern California were analyzed for the physical characteristics known to affect fire behavior, such as density, fuel loading, and fuel bed porosity. Considerable variation was found, but results are helpful in developing estimates of chamise fuel characteristics for fire control under field conditions.

Pub. 1970: 20p. NTIS No. PB-207 832: MF \$0.95.

Abstract: In the 1968 Canyon Fire in southern California, a fire flareup fatally burned seven Los Angeles firefighters and their foreman. A fire whirl that triggered the flareup appeared to have been caused by a sudden local increase in wind speed or other disturbance in the airflow. A situation conducive to sudden flareups was produced by fluctuating winds combined with unstable atmospheric conditions and a high fire danger index.

Pub. 1969: 25p., NTIS No. PB-193 694: MF \$0.65.

SUPPORTED BY U.S. Dept. of Agriculture

5.0005, GUIDES FOR FUEL-BREAKS IN THE SIERRA NEVADA MIXED-CONIFER TYPE

L.R. GREEN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: Fuel modification has been proposed as an answer to California's wildfire problems. But practical consideration limits treatment of fuels to strategically located wide strips or blocks of land called fuel-breaks. Fuel-breaks have a low-growing ground cover that offers less resistance to fire control efforts, and they provide safe access for firefighting forces on the ground. Guides for the construction and maintenance of fuel-breaks are outlined.

Pub. 1971: 18p., NTIS No. PB-207 873: MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

5.0006, FOREST FIRE BEHAVIOR - CALIFORNIA

C.M. COUNTRYMAN, U.S. Dept. of Agriculture, Pac. S.W. For. & Rg. Expt. Sta., Riverside, California 92507

Objective: Identify and define specific predictors of dangerous or unusual forest fire behavior and incorporate these predictors into practical guidelines for fire-fighting and fire use activities.

Approach: Develop new fire behavior concepts and theories to improve the safety and efficiency of firefighting and prescribed fire operations. Identify in the forest environment the most important predictors of dangerous or unusual forest fire behavior by studying the behavior of forest fires, and by assimilation of data from basic laboratory studies such as fire physics and combustion research. Formulate practical fire behavior guidelines to enable fire managers to control wildfires safely and conduct prescribed burning operations efficiently.

Progress: Major physical characteristics affecting fire behavior have been determined for three California fuel species--red shank, deer brush, and manzanita. Fuel moisture boundary conditions for ignition of thin layers of grass fuel by cigarettes have been determined for one wind speed and air temperature. Manuscripts for publications to be used in training of firefighting personnel in radiative heat transfer and its effects on fire behavior and fire control have been prepared, and on the principles and applications of fire danger rating have been prepared. A manuscript describing the conflagration fire problem in southern California and suggesting a solution has been prepared. A paper describing Project Flambeau, summarizing its results, and indicating the further research needed in mass fire in urban and wildland areas has been prepared.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

menting new principles into existing and new fire management systems, and improve efficiency of fire planning and firefighting operations.

Approach: Develop new fire planning principles, develop methods for evaluating the incommensurable and intangible forest values at stake, develop computerized information systems to assist fire managers in applying advance systems analyses techniques to complex fire control problems, and develop more efficient firefighting tactics for potentially dangerous fires.

Progress: Portions of a large-scale computer simulation model are being completed or refined while other phases have not been started. Second version of initial attack model capable of handling multiple fires and integrate air and ground attack, including air tankers, has been completed and is being tested. Work started on reinforcement action version that will integrate efforts of cooperators and non-fire personnel and equipment. Data base is largely completed, and a coordinate digitizer has been put into operation. Most digitizer software has been written. Transportation systems for eight national forests are largely completed. Aerial data, such as lookout seen areas and fuel type areas, are now being digitized. Detection portion of the model has been started. The first version compares lookout seen areas to fire recurrence patterns and determines the potential effectiveness of the lookouts in order of their performance. Some work has started in coordinating with aircraft patrol observations. The system that simulates location, time, and series length of multiple lightning fires has been completed. Work has started on the simulated patterns of man-caused fires. A study to evaluate the cost of candidate fire protection plans is eighty percent complete. Cost model considers the financing of the plan as a stream of fixed and variable costs over time. Plans are discounted to present worth.

SUPPORTED BY: U.S. Dept. of Agriculture - F.S.

5.0008, CONTRACT FOR PARTIAL SUPPORT OF THE COMMITTEE ON FIRE RESEARCH

N.T. GRISMORE, Natl. Acad. of Sciences, Washington, District of Columbia 20037 (NSF C-310-086-011)

Partial support is provided for the Committee on Fire Research that was formed in 1955 to advise and consult on the development and conduct of a research program directed at an understanding of the spread and control of conflagrations of the fire storm and forest varieties. In recent years the interest has been increasingly directed toward prevention and suppression of urban fires, and those occurring at the interface of wild lands and metropolitan areas. The Committee will publish three numbers of 'Fire Research Abstracts and Reviews,' publish and distribute the Seventh Edition of 'Directory of Fire Research in the United States.' Two symposia are planned: (1) toxicological problems caused by smoke and (2) pollution problems caused by smoke due to urban and forest fires. The Committee will continue its basic mission of advice, recommendation, and persuasion leading to the identification and solution of real fire problems.

SUPPORTED BY: U.S. Natl. Science Foundation

5.0009, EMPLOYMENT OF AIR OPERATIONS IN THE FIRE SERVICES - PROCEEDINGS OF A SYMPOSIUM, HELD AT ARGONNE NATIONAL LABORATORY (AB-BREV)

UNKNOWN, Natl. Acad. of Sciences, Washington, District of

Forest fire attacks, Helicopter fire fighting in VECR, Aircraft and facilities (Helicopter accessories for fire fighting), Manufacturers' specifications and aircraft performance, Helicopter flight restriction and fire service operations. Communications are essential. Operation and safety problems, Strategy and tactics in an attack (Integrating an attack with fire-fighting strategy, Fire fighting - chemicals, Diversified helicopter services, Current techniques employed by USM helicopters in crash fire operations, Fire intelligence, General summary and development), Helicopter display and fly demonstration by manufacturers.

Pub. 1971; 147p., NBS No. AD 734 078. PC \$1.00 MF \$0.95
SUPPORTED BY: Natl. Academy of Sciences - Washington

5.0010, A STUDY OF FOREST SERVICE TELECOMMUNICATIONS - VOLUME I SUMMARY MAIN STUDY RECOMMENDATIONS AND FINDINGS

UNKNOWN, U.S. Dept. of Agriculture, Div. of Administrative Mgmt., Washington, District of Columbia 20250

Abstract: The objectives of the Forest Service Telecommunications study were to: (1) Evaluate the management of the radio system needed to satisfy the communication requirements of present and future Forest Service programs; (2) Provide methodologies and recommendations for evaluating requirements, financing procedures and organizational structure for electronics and communications management taking into account alternative nonradio communication systems; (3) Provide solutions to some critical large fire communication problems.

Pub. Nov. 72; 46p., NBS No. PB 233 187/5. PC \$1.50 MF \$1.45

SUPPORTED BY: U.S. Dept. of Agriculture

5.0011, DEVELOPMENT OF NEW AND IMPROVED FIRE CONTROL METHODS FOR SOUTHERN FORESTS

REE JOHANSEN, U.S. Dept. of Agriculture, S.E. Forest Experiment Station, Macon, Georgia 31201 (SE-F-002)

Objective: Evaluate new or improved firefighting techniques, tools, equipment, and chemicals for southern forests.

Approach: Seek out and perfect new approaches to fire control by analyzing existing fire control techniques. Evaluate findings from national projects (equipment development, fire detecting, operations research, firefighting methods, fire danger rating, and chemical retardants) for use under southern conditions. Evaluate firefighting chemicals in three phases: developing a measurement method for rating toxicity; determining application rates; and determining logistics for handling chemicals. Identify adjuvants and additives to improve the effectiveness of current retardants. Evaluate fire control equipment.

Progress: The effective use of U-gate shotgun igniters developed for the Southern Forest Fire Laboratory to remotely ignite fuel from a road has been demonstrated on two forested areas. Artillery impact areas at Fort Stewart, Georgia were prescribed burned by firing hoses from military helicopters in a spot-grill pattern. The identical torus technique has also been used in remote areas of the Everglades National Park in Florida from a leased helicopter. A Delholland Beaver aircraft outfitted with external 400-gallon tanks can build effective fireline when dropping ammonium phosphate fire retardant solutions.

SUPPORTED BY: U.S. Dept. of Agriculture - F.S.

5.0012, THE COAST GUARDIAN: A STUDY OF THE

will land fires swept into Oakland, the Newhall, Chatsworth, Simi, Malibu and Cajon Pass areas of Los Angeles County, and the Alpine, LaCresta, Jannul and Harbison area of San Diego County. The NOI-SRI Fire Research Group investigated four of these fires to determine factors that enabled wild land fires to enter urban areas, why some houses survived while those around it burned and the role of self-help. These fires followed the pattern expected during hot, dry weather at the end of summer when strong winds drive flames out of control.

Pub. Nov. 71: 82p., NTIS No. AD-736 605; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Navy

5.0013, STUDIES OF IMAGES OF SHORT-LIVED EVENTS USING ERTS DATA - ALASKA

W.A. DEUTSCHMAN, Smithsonian Institution, Cambridge, Massachusetts 02138

Abstract: The author has identified the following significant results. It has been possible to identify old fires in the Alaskan tundra and to monitor the development of active fires. The area burned can be quickly determined by a number of methods. The ERTS-1 satellite provides a convenient way to monitor fire damage in remote areas.

Pub. Dec 72: 3p., NTIS No. F73-10025; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

5.0014, FIRE CONTROL, PLANNING AND FIRE PREVENTION IN THE NORTHEASTERN UNITED STATES

V.J. JOHNSON, Michigan State University, U.S.D.A. N. Co., For. Ex. Sta., East Lansing, Michigan 48823 (NC2101)

Objective: Develop and apply weather and fire danger information needed for fire control planning, describe and characterize forest fuels, and develop and test methods for reducing the incidence of man-caused fires.

Approach: After empirically identifying the meteorological and climatic elements that contribute to large fire occurrence, a fire atlas will be made for the northeastern and north central States that will be useful for developing regional and interstate mobilization plans. Selective forest fuel information will be collected from various locations in the 21-State area and merged with data already on hand to develop regionwide fuel information. Concurrently, methods for rapidly sampling fuels will be devised. Fuel data will be interpreted in terms of its effect on fire behavior and incorporated into theoretical fire behavior models which will be validated by making pilot burn tests. Fire causes will be related to fire weather, fuel hazards, public activity, and other factors in an effort to identify where the fire prevention research effort should be concentrated. Cost analyses of various fire prevention techniques will be made, with the initial approach concerned with railroad-caused fires. Based on the success of developing prevention techniques for railroad fires, other aspects of fire prevention will be investigated.

Progress: Fuel treatment guides for Northeastern National Forests were developed from currently available fire behavior models combined with empirical fuel data. The guides include computer generated graphical displays of expected rates of spread and fire line intensities for various levels of slash loading and fuel depths in Eastern forests. Projections of slash production under various stocking levels and basal areas by species are displayed in tabular form. A climatology of precipitation duration has been assembled for use with the National Fire Danger Rating System. The climatology gives

seven years of individual fire cause data from 17 Northeastern National Forests isolated various combinations of fire and specific causes, and the activity and class of fire responsible for man-caused fires.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0015, FOREST FIRES IN MISSOURI

D.A. HAINES, U.S. Dept. of Agriculture, North Central Forest Expt. Sta., St. Paul, Minnesota 55101

Abstract: The report describes factors that contribute to forest fires on two of the state of Missouri's protection districts in the Clark National Forest. It includes an analysis of fire cause, annual distribution, weather, and activity by county, week; and also discusses multiple-fire days.

Pub. May 73: 22p., NTIS No. PB-223 513/3; PC \$2.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Agriculture

5.0016, FIRE WEATHER & BEHAVIOR OF THE 1971 SIOUX FIRE - MINNESOTA

R.W. SANDO, U.S. Dept. of Agriculture, North Central Forest Expt. Sta., St. Paul, Minnesota 55101

Abstract: In mid-May 1971, a northern Minnesota fire burned almost 15,000 acres of forest land. Abnormally dry weather caused mild drought during a time of year when vegetation was still in the cured stage. Ignition began during one of the most severe fire-weather days experienced in the history of the Superior National Forest. The spread of the fire was enhanced by extensive cutover areas and grass marshes. Fires were a significant problem: their ignition and spread were greatly assisted by the dead fuels remaining from a spruce budworm outbreak of the early 1960's. Intense fires occurred in areas where the forest stands were young. Among the many complicating weather factors were shifts and high velocities associated with rapid frontal passages through the area.

Pub. Apr. 72: 12p., NTIS No. PB-223 411/0; PC \$2.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Agriculture

5.0017, RESEARCH AND DEVELOPMENT OF FIRE PREVENTION TECHNOLOGY (FIRE PREVENTION)

M.L. DOOLITTLE, Mississippi State University, U.S.D.A. Forest Expt. Sta., State College, Mississippi 39762 (SO2101)

Objective: Develop a system for forecasting long-range fire risk in man-caused fire occurrence and produce guidelines for incendiary fire problem analysis and prevention program.

Approach: Systematically analyze the association between fire occurrence and physical, social, economic, demographic, and political variables in a search for reliable and valid indicators of fire occurrence variation. Intensive study of a wide range of localized incendiary fire problems will produce most information upon which fire problem analysis guidelines will be based. Experimental and current prevention measures will be installed and evaluated following most of the studies. Study of incendiary fire problems, and prevention measures will augment the major effort.

Progress: A study of man-caused fire risk in six Southern States was designed to systematically analyze the structural, situational, and cognitive dimensions of risk. Upon the completion of the study, it was concluded that much of the variation in accidental fire occurrence can be explained

5.0018,

population density, rurality, and socio-economic status. Attitudes and knowledge about forest fire use and effects were more closely associated with incendiary fire occurrence than with accidental occurrence. The results of this study added significantly to an understanding of the nature of man-caused risk and are being used as a basis for research planning. An objective prediction of fire occurrence is a prerequisite for prevention program evaluation. In a recent evaluation of a personal contact program, the technique of using multiple regression as a predicting method in analyzing fire occurrence over time showed promise. A regression using two parameters reflecting weather variation (Spread Index and Class Fire Day), over a five year period of 40 monthly observations, yielded a highly significant equation, accounting for 65% of the variation in monthly fire occurrence.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0018, PHYSICAL, CHEMICAL, AND PHYSIOLOGICAL PROPERTIES OF FUELS RELATED TO FIRE PHENOMENA

H.E. ANDERSON, U.S. Dept. of Agriculture, Intermt. For. & Rg. Exp. Sta., Missoula, Montana 59801 (INT2104)

Objective: Determine and describe quantitatively those properties of forest and range fuels which affect ignition, spread and intensity of fire.

Approach: Investigate the physical and chemical properties of individual fuel particles that influence the ways they ignite and burn. Study the factors which determine the rates at which fuels exchange moisture with the atmosphere and the influence of heating on fuels and time-temperature curves for both spontaneous and pilot ignition of various fuels. Contribution toward the development of an ignition index for the National Fire Danger Rating System is an objective of the ignition research.

Progress: Research efforts have generated fuel inventory procedures, knowledge of fire history and fuel characteristics, data on growth cycles, seasonal change and daily variation, information on ignition properties of fine forest fuels, and consolidation of fuel data for appraisal, management, fire planning, fire-danger rating, and aerial attack research. The Region 1 Stage 1 resource inventory now incorporates fuel inventory methods and procedures. Computer programs for utilization of the data have been prepared; output is or will be used for two National Forests, R-1 Wilderness Study, INT-Wyoming Study. Data of crown weights is being gathered to improve residue weight estimates. Ecological land unit descriptions have been developed for the basis to the approved fire management plan in the R-1 wilderness study. Spontaneous and pilot ignition characteristics of pine needles, rotten wood, and cheatgrass are being documented and provide input to crowning and spot fire hazard considerations. Fuel appraisal elements have been identified and methods of relating to field personnel explored. The retardant retention efficiency by fuel size has been studied and results interpreted for use in the aerial attack research program. This research is providing essential data for the development of fire spread and intensity models, fire-danger rating, development of a fuels appraisal system, inputs to aerial attack research, and land management resource inventory requirements.

Objective: To determine the basic characteristics of fire-lightning storms and methods and systems for their prediction and modification.

Approach: (A) Studying the physical processes involved in formation, movement, and behavior of lightning storms. Describing the properties of lightning discharges, including the characteristics of charge centers and the conditions for strikes. (C) Studying physical processes related to the development of thunderstorms. (D) Studying the techniques, and results of weather modification procedures.

Progress: A mathematical cumulus cloud model was developed utilizing various aspects of existing cloud models. A comparison of the steady-state model indicates good agreement between a simulated cloud and measurements obtained of natural cumulus clouds. Additional work is required to produce a model that can be used to study Rocky Mountain thunderstorms. A cooperative lightning modification study between the Bureau of Land Management and the USDA Forest Service was initiated in 1973. The study is designed to evaluate the effect of HLM cloud seeding on the modification of Alaskan lightning storms. A study plan and implementation are presently being prepared for the study. We have established that lightning discharges with long durations are the cause of most forest fire ignitions and that the probability of ignition is proportional to the current duration. Results from thunderstorm seeding experiments during 1965-67 show that, for this pilot experiment, cloud seeding reduced both the frequency of occurrence and the duration of long-continuing discharges. These results strongly imply that, if the effects of seeding on cumulus clouds can be reproduced on an operational basis, the seeding can be expected to substantially reduce the probability of forest fire ignition by lightning from treated storm clouds. Additional evaluation of the effects of seeding on lightning under field conditions are required before a system can be made of potential operational programs.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0020, CONTROL AND USE OF FIRE PARTICLES IN WILDERNESS, PARK, AND OTHER RECREATIONAL AREAS

C.E. HARDY, U.S. Dept. of Agriculture, Intermt. For. & Rg. Exp. Sta., Missoula, Montana 59801 (INT2102)

Objective: Incorporate research findings into the most effective means of solving the fire control problems of wilderness, park, and recreational area management. Determine the use of fire in resource management and the fire resistance characteristics most suitable for fire control.

Approach: Develop a problem analysis of wilderness, park, recreational area management in reference to fire needs. Determine use of fire for hazard reduction and land management purposes. Screen fire retardant chemicals for suitability in fire control. Other research will focus on fire danger rating and its interpretation by user agencies.

Progress: A series of aircraft tests conducted last year have provided data on trajectory and ground patterns on several different tank configurations and degrees of turbulence (C-130 MAPS), retardant rheologic properties, aircraft altitude and speed, and crosswind. Some of the data are being used in the development of a fire control system for wilderness areas.

will help in comparing effects of other chemicals and additives

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0021. A MODEL OF THE FORESTS OF GLACIER NATIONAL PARK, MONTANA

R.H. WHITTAKER, Cornell University, School of Biological Sciences, Ithaca, New York 14850

Dr. Whittaker and his graduate student, Stephen R. Kessell, will investigate the forests of Glacier National Park, Montana, with a view toward the development of gradient models for three different approaches to the study of the distribution and structure of the forests: 1) a direct habitat-gradient analysis along elevation and topographic parameters, 2) an indirect gradient analysis of low-elevation lake influences and high-elevation wind-snow-exposure influences, and 3) a time gradient analysis of succession after fire. The component tree species will be viewed as distributed along the axes of the habitat hyperspace. An important aspect of the proposal is its potential for testing hyperspace and niche models in vegetative systems. In addition the results of field work and infrared photography will provide vegetation maps. The results of the successional study should permit predictions that will be useful for controlled fire management in Glacier National Park.

SUPPORTED BY U.S. Natl. Science Foundation

5.0022. EFFECT OF PRESCRIBED BURNING ON WATER YIELD AND QUALITY FROM BRUSH INFESTED LANDS - TEXAS

H.A. WRIGHT, Texas Technological University, School of Agriculture, Lubbock, Texas 79409

The proposed research plan involves studying the effect of prescribed burning on watershed cover, soil movement, overland flow, and water quality over a period of three years on an Ashe Juniper site. Replicate micro-watersheds will be constructed on three degrees of slopes in both (1) areas to be burned and (2) in areas not to be burned.

The specific area of study is about 40 miles east of Abilene, Texas, on the Caldwell Ranch.

The study will evaluate soil movement, overland flow, and water quality (determined by mechanical analysis and organic matter content) in relation to watershed cover, degree of slope, and intensity and duration of storms. Hence, fire study is designed to measure the magnitude of water yield, sedimentation, and water quality following a burn in relation to various degrees of cover and slope. If burning is going to be practiced, what are the gains and losses, and what are the sites where burning should not be allowed, if any, for maximum sustained yield and quality?

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

5.0023. NATURAL DISASTERS OPERATIONS PLANNING FOR SLOWLY DEVELOPING DISASTERS. VOLUME I

A. SACHS, Inst. for Defense Analysis, Arlington, Virginia 22202

Abstract: The paper describes a prototype natural disaster operations plan for slowly developing natural disasters such as hurricanes, floods, droughts, etc. An imagination was

SUPPORTED BY U.S. Dept. of Defense - Army

5.0024. MECHANISMS OF WILDLAND FIRE SUPPRESSION

R.C. CORLETT, Univ. of Washington, School of Engineering, Seattle, Washington 98105

The ultimate objective is rational understanding of wildland fire response to fire suppression measures for use in the development of proper equipment, attack strategies, and management techniques that will minimize costs. Specifically, the research will delineate controlling suppression mechanisms for a set of fire situations and formulate meaningful field experiments, through analysis and laboratory experiments in cooperation with the U.S. Forest Service.

One phase of the program is the development of an understanding of the response of representative wildland fuel beds to the environment posed by the gas-phase fire, in conjunction with thermal and chemical disturbances due to suppressive action. A concurrent phase is the development of an understanding of the response of the gas-phase combustion processes when changes are imposed through modification of condensed-phase, ambient conditions, or through direct modification of the flame itself from suppressive actions.

Following an analytical integration of the two components, experiments will be conducted to validate and improve the models for the description of fires subjected to suppressive actions. The first suppressant will be water, followed by dry powders. Field experiments that can establish the validity of the formulated model will be specified.

SUPPORTED BY U.S. Natl. Science Foundation

DISASTER MITIGATION

5.0025. FIRE PREVENTION - CALIFORNIA

W.S. FOLKMAN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Objective: Define and quantify the parameters affecting risk; to measure the fire prevention knowledge and attitude of representative groups of forest users; and to develop measures for evaluating fire prevention programs.

Approach: Conducting a pilot study of fire prevention methods in a test community in Butte County, California; conducting a resurvey to determine changes in fire prevention knowledge and attitudes of county residents; and analyzing 'fire prevention' content of newspapers of the area. Evaluating prevention films developed for use as television 'spots'; testing effectiveness of special programmed conservation education materials in lower school grades; and studying fire prevention signing and other preventive materials and techniques. Identifying and characterizing high-risk forest users. Studying the organizational characteristics of forestry activities related to the effectiveness of fire prevention efforts.

Progress: Evaluation of the experimental fire prevention program in Butte Co., California showed little change in levels of knowledge and attitudes among the resident population from 1964 to 1970. Fire records do show a drop in fire starts in the county during period of intensive prevention activity, especially during the summer months.

in normal viewing. Youth film was found to be more effective than Smokey film in making people in general more concerned about fire law enforcement. A coordinated program for teaching fire prevention and conservation education to children (K-3) has been developed from the studies at Ohio State and the Headstart Project.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0026, URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, loss of mineral resources to urbanization, landsliding, flooding, erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of possible loss-reduction measures, and agencies responsible for those measures.

Pub. Jun 73: 111p., NTIS No. PB-222 447/5; PC \$7.75 MF 1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

5.0027, NATIONAL FIRE DANGER RATING

J.W. LANCASTER, Colorado State University, U.S.D.A. Rocky Mtn. Exp. Sta., Fort Collins, Colorado 80521 (RM2106)

Objective: Develop a fire-danger rating system suitable for use by all wild-land fire control agencies

Approach: The system will include as a minimum a dispatching index, a presuppression index and a seasonal severity index. All indexes and guides will be developed from existing information or information provided concurrently by other fire research work units. The dispatching index will be a suitable combination of a rate-of-spread and a rate-of-combustion index. The presuppression index will be a combination of the dispatching index and potential numbers of fires. Presuppression indexes can be accumulated to provide a seasonal severity index. Guidelines for defining areas sufficiently homogeneous for fire danger rating will also be provided.

Progress: NFDR system implementation proceeded on a large scale in 1972. The U.S. Forest Service adopted it, and most USFS Regions have completed installation. Other users in 1973 are the National Park Service, Bureau of Indian Affairs and, at least 15 States. The Bureau of Land Management plans adoption in 1974. Joint implementation efforts are given high priority, and cooperative efforts have resulted in new methods of smoothing the transition. Means of obtaining full advantage of new NFDR capabilities are being explored with users. Computer software work resulted in program AF-FIRMS, which will undergo 1973 field trials. It yields real-time observed and forecast NFDR numbers, sets preparedness levels, and archives data. Any subscriber in the United States may access this program after it is released for use in the Fall of 1973. Contracts will complete the principal work remaining on the fuel moisture analog, and the manual weighing scheme will undergo field trials in 1973. Electronic analog measurement investigations continue. Calcometer data

times, as do smudge-fuel moisture studies, operational NFDR applications, and optimization of rating station networks through fire climate analyses.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0028, AIRBORNE INFRARED FOREST FIRE DETECTION SYSTEM

R.A. WILSON, U.S. Dept. of Agriculture, Northern Forest Fire Lab., Missoula, Montana 59801

Abstract: The report outlines the basic requirements for an airborne infrared forest fire detection system and discusses the capability of the system to detect hot fire targets in natural forest backgrounds.

Pub. May 71: 111p., NTIS No. AD-726 953; PC \$4.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

5.0029, RADAR METEOROLOGY AS A MODERN TOOL FOR FOREST FIRE PROTECTION

D.W. KRIEGER, U.S. Dept. of Commerce, Natl. Weather Service, Atlantic City, New Jersey

Abstract: The National Weather Service works now with over many of the country's forests. Pictures from these radars can be remitted to Fire Control Offices and National Weather Service Forest Meteorologists. Data from the radars have a great deal of potential value to fire control officers. Some applications include (1) helping to determine areas of high or low buildup index, (2) locating areas to be searched for possible lightning caused fires, (3) delineating windshifts approaching going fires and (4) showing paths of showers that may reduce fires or assist mop up.

Pub. 1971: 11p., NTIS No. COM-71 00601; PC \$4.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

5.0030, THE DETECTION OF CENTERS OF COMBUSTION OF SMALL DIMENSIONS BY THE METHOD FOR IR PHOTOGRAPHY

P.I. BINENKO, U.S. Air Force, Foreign Technology Division, Dayton, Ohio 45433

Abstract: The need for seeking a new, reliable method which makes it possible to detect centers of combustion in forest fires in early stages of their development is well known. Such a method can become the method of infrared photography from aircraft. The purpose of the report is to evaluate the possibilities of using infrared scanning equipment for the detection of centers of combustion of small dimensions.

Pub. May 73: 17p., NTIS No. AD-762 265; PC \$4.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0031, OPERATING PLAN FOR FIRE WEATHER SERVICE IN SOUTH CAROLINA

J.D. KANUPP, U.S. Dept. of Commerce, Natl. Weather Service, Columbia, South Carolina

Abstract: The publication contains the operating plan for fire weather service in South Carolina. It describes the service and methods of obtaining it. It explains details on how fire weather observations are made and reported and provides phone numbers of fire weather offices and residence phone numbers of fire weather forecasters. Details on fire weather warnings and advisory weather information/briefings during critical fire weather situations are included.

5.0032, CORRELATION OF SATELLITE AND GROUND DATA IN AIR POLLUTION STUDIES (ABBREV)

G.E. COPELAND, Old Dominion University, Graduate School, Norfolk, Virginia 23508

Abstract: The author has identified the following significant results. Analysis of U-2 imagery of CARETS site indicates smoke plumes can be easily detected. First look at selected ERTS-1 color composites demonstrates plumes from forest fires can be detected.

Pub. Sep 72: 12p., NTIS No. E72-10160; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

HAZARD REDUCTION

5.0033, FIRE ENVIRONMENTAL TEST CHAMBER - ITS DESIGN AND DEVELOPMENT

C.J. AUVIL, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: The Fire Environmental Test Chamber at the Forest Fire Laboratory, Riverside, California, can duplicate under controlled conditions the key factors that affect the flammability of wildland fuels. Within certain limits, it can produce air flow, solar radiation, temperatures, and relative humidity. First developed in 1962, the test chamber has since then undergone several modifications to meet requirements over and above the original capabilities. The characteristics of the test chamber and nature of the changes are explained. Recommendations on design and development are offered.

Pub. 1973: 10p., NTIS No. PH-225 402/1; PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Agriculture

5.0034, FIRES CAUSED BY EQUIPMENT USED DURING CRITICAL FIRE WEATHER IN CALIFORNIA, 1962 - 1971

G.C. BERNARDI, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: Use of certain types of equipment during fire season is a major cause of forest fires in California. To determine what these types are and the characteristics of people using them, the fire investigation reports for one unit of the California Division of Forestry were analyzed for critical fire weather periods over a 10-year span. Roadway vehicles - automobiles and trucks - were responsible for most of the equipment-use fires. But few such fires, when starting in critical fire weather, reached major proportion. Most of the major roadway vehicle fires started during non-critical periods. Recommendations for Improving the Fire Investigation Reports and for new regulatory measures are offered.

Pub. 1974: 8p., NTIS No. PB-231 080/3; PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Agriculture

5.0035, ALLOCATION MODEL FOR FIREFIGHTING RESOURCES

F.W. BRATTEN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: A study is underway to develop computer techniques for planning suppression efforts in large wildfires. A mathematical model for allocation of firefighting resources in a going fire has been developed. Explicit definitions are given for strategic and tactical planning functions. How the model might be used is illustrated by a fictitious but realistic

SUPPORTED BY U.S. Dept. of Agriculture

5.0036, CHARACTERISTICS OF PEOPLE WHO START FIRES - SOME PRELIMINARY FINDINGS - CALIFORNIA

J.R. CHRISTIANSEN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: Recreationists or city dwellers are usually most often thought of as being responsible for starting forest fires. But a limited study showed that fire starters were more apt to be people who lived near and worked on the national forests. They were relatively young and undereducated, and had good reputations in their communities. Employers held responsible for forest fires started by their employees most often had multiple fire violations, but good reputations in their communities. These and other characteristics of fire-starters were identified by analyzing 165 fire trespass reports from the Forest Service's California and Intermountain regions.

Pub. 1971: 7p., NTIS No. PB-107 883; MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

5.0037, REDUCING FIRE HAZARD IN PONDEROSA PINE THINNING SLASH BY MECHANICAL CRUSHING - OREGON

J.D. DELL, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: Precommercial thinning in ponderosa pine stands in the Western United States is a growing practice. Thinning slash can, however, be a serious fire hazard in dry areas. Crushing and compacting this slash may be one way of reducing the hazard. Three types of mechanical crushers were tested on the Deschutes National Forest, Oregon. Results indicate that at least one of these methods of mechanical crushing is effective for lessening the fire hazard in thinning slash, and can be done at reasonable costs.

Pub. 1969: 14p., NTIS No. PB-193 696; MF \$0.65.

SUPPORTED BY U.S. Dept. of Agriculture

5.0038, FOREST FIRE HISTORY - A COMPUTER METHOD OF DATA ANALYSIS

R.M. MEES, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: A series of computer programs is available to extract information from the Individual Fire Reports (U.S. Forest Service Form 5100-29). The programs use a statistical technique to fit a continuous distribution to a set of sampled data. The goodness-of-fit program is applicable to data other than the fire history. Data summaries illustrate analysis of fire occurrence, detection and initial attack time, and space and time relationships of multiple fires.

Pub. 1972: 9p., NTIS No. PB-225 397/9; PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Agriculture

5.0039, PROBABILITY FIRE WEATHER FORECASTS SHOW PROMISE IN 3-YEAR TRIAL

P.G. SCOWCROFT, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta., Berkeley, California 94701

Abstract: Probability fire weather forecasts were compared with categorical and climatological forecasts in a trial in southern California during the 1965-1967 fire seasons. Equations were developed to express the reliability of forecasts and degree of

probability forecasting to be used operationally. The necessary computations and some decision criteria for planning.

Pub. 1970. 7p., NTIS No. PB-207 794; MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

5.0040, FOREST FIRE METEOROLOGY IN THE PACIFIC COASTAL REGION

M.J. SCHROEDER, U.S. Dept. of Agriculture, Pac. S.W. For. & Rg. Exp. Sta., Riverside, California 92507 (PSW2108)

Objective: Define and describe topscale and mesoscale weather patterns in the Pacific coastal region which affect the ignition and spread of wildfire; determine how these patterns vary and how they are affected by larger scale patterns, heating, topography, and forest characteristics.

Approach: Study problems caused by continental air masses, marine air masses, and their interactions. Conduct an analysis of existing weather data to determine mesoscale patterns of marine air or continental air invasions. Conduct field studies to measure topscale patterns in three dimensions. Develop theoretical mathematical or physical models of the meso- and topscale weather patterns using analyses of field data as guides.

Progress: Three kinds of mesosystems—two squall mesosystems, an instability line, and a strong marine push—were observed in Oregon on the same day. Each system produced sudden changes in temperature and gale-force winds, yet none was identified on routine synoptic analyses. The impact of these mesosystems emphasizes the need for greater attention to mesoscale systems for identification and warning of important summer weather events. A detailed study resulted in several important findings: photochemical oxidant that formed in the marine layer is vented up the slopes and over the crest of the San Bernardino Mountains during the day; layers of high oxidant concentrations were detected above the inversion base, suggesting that some pollution is vented up the slopes and subsequently advected back above the inversion base, and the diurnal changes in the temperature inversion also contribute to the high concentration found within the inversion. These processes result in multi-layers of pollution. The study suggests that oxidant air pollution is transported up to 80 mi. to forested mountains, where severe damage to conifer species has been documented. Measurements of oxidant air pollution, temperatures, and wind speeds were made in the Central Valley, Sierra Nevada foothills, and a high mountain valley. Evidence was recorded of the transport of photochemical smog from the Central Valley to Mineral King. FIRDAT, a Fortran IV program has been written to compute the daily components and indexes of the National Fire Danger Rating System.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0041, FOREST FIRE STATISTICAL PROBLEMS

F.N. DAVID, Univ. of California, School of Agriculture, Riverside, California 92502

The objective is to solve some statistical problems that have arisen in connection with the development of a basic simulation model for forest fire control by the Forest Fire Laboratory of the Pacific Southwest Forest and Range Experiment Station of the Forest Service. In cooperation with the Forest Service, which will make its data available, the following statistical studies will be investigated in order to improve the simulation model: 1) distribution of fire starts related to probable cause and terrain, 2) production rates of fire line

relative to terrain and weather conditions, 3) the efficiency of data base and the handling of the data, 4) possible associative quantities can be retrieved quickly.

SUPPORTED BY U.S. Natl. Science Foundation

5.0042, DEVELOPMENT OF IMPROVED TECHNIQUES FOR USING PRESCRIBED FIRE IN SOUTHERN PINE FORESTS

R.B. COOPER, U.S. Dept. of Agriculture, S.E. Experiment Station, Macon, Georgia 31203 (SE-2101)

Objective: Develop improved methods of using fire to manage fuel areas and to accomplish silvicultural objectives. Determine stand, fuel, and weather conditions under which appropriate firing techniques will produce a fire of the desired intensity and behavior; to be alert to alternative fuel reduction.

Approach: Developing improved instrumentation for measuring both the prescribed fire and its environment. Determine relationships, heat yield, and flame characteristics of primary interest. Continuing studies in fire behavior techniques. Studying the use of prescribed fire for hazard reduction. Evaluating other promising techniques for hazard reduction or prevention of fire from hazards.

Progress: About two-thirds of the annual forest and burning in the South is done in January, February, and March. Maximum particulate levels in total suspended matter recorded in April and May with a secondary peak in October coinciding with maximum prescribed fire activity. Particulate counts averaged out at about 35 micrograms per cubic meter throughout the year. When little or no burning takes place before actual ignition of living vegetation, particulate production may exceed 100 pounds per acre burned; when preheating is extensive prior to ignition, particulate production may be less than 10 pounds per acre burned. Hydrocarbon and carbon monoxide production is the same general trend. The manner in which fuel is put into the air is a function of the type of fuel consumed, its moisture content, the rate of fire spread, and the rate of fire spread. The manner in which fuel is dispersed is a function of atmospheric stability, wind velocity. Prescribed fires may actually enhance air pollution by reducing the number, size, and intensity of fires and their resulting atmospheric contamination.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0043, THE INFLUENCE OF WEATHER AND TOPOGRAPHY ON FOREST FIRE OCCURRENCE AND BEHAVIOR IN THE EAST AND SOUTH

D.T. WILLIAMS, U.S. Dept. of Agriculture, S.E. Experiment Station, Macon, Georgia 31203 (SE-2103)

Objective: Identify, measure, and correlate meteorological variables and establish how the interrelationships of these variables affect fire potential and behavior.

Approach: Studying humidity as related to fuel moisture, identifying situations leading to air mass inversions, and convection phenomena. Studying the interaction of the continental and maritime air masses. Continuing analyses of fire, weather, and fire damage measurements on going fires, and case studies. Identifying extreme behavior to provide information for forest managers in interpreting danger ratings during periods. Defining elements involved in the depletion of moisture of forest fuels caused by long-term drought.

Progress: Sea breeze fronts occur in coastal Georgia on about one-third of the days during late winter and early spring. A simple method, which uses morning wind speeds and the expected afternoon maximum temperature, permits crews to determine whether or not a sea breeze front will influence a fire. Maximum fire danger in coastal Georgia occurs at 1300 EST in summer and 1500 EST in winter. Lightning-strike fires in southeastern Georgia are more likely on thunderstorm days with high values of buildup and spread index than on other thunderstorm days. Smoke from the Florida Everglades fires of 1971 restricted visibilities and limited aircraft takeoffs and landings at Palm Beach International Airport during 17 days in April, but amounts of particulates did not exceed the national standard for air quality.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0044. DEVELOPMENT OF EMISSION FACTORS FOR ESTIMATING ATMOSPHERIC EMISSIONS

G. YAMATE, IIT Research Institute, Chicago, Illinois 60616

Abstract: This report contains emission factors (weight of pollutant per acre burned) for estimating atmospheric emissions from forest fires (especially wildfires) for each of the ten U.S. Forest Service regions in the U.S. The pollutants considered are: total particulates, hydrocarbons, carbon monoxide, nitrogen oxides, and sulfur oxides. Data on acreage consumed by wildfires are used with the factors to estimate mass emissions for each region. The effects of such variables as terrain, density of vegetation coverage, type of vegetation, wind speed, and humidity are also discussed. Finally, proposed approaches to mathematically correlate these variables (via empirical and theoretical models) with both emission factors and mass emissions are presented.

Pub. Oct. 73: 147p., NTIS No. PB-230 889/8: PC \$4.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

5.0045. FIRE WHIRLWIND FORMATION OVER FLAT TERRAIN

D.A. HAINES, U.S. Dept. of Agriculture, North Cen. Forest Expt. Stn., St. Paul, Minnesota 55101

Abstract: Case studies indicate that optimum conditions for development of flat-terrain, fire whirlwinds include: (1) A fire of sufficient acreage and intensity to create the heat source. Methods of burning are also important. (2) A superadiabatic lapse rate through the lower 300 to 400 feet with a lapse near the dry adiabatic for favorable lapse rate. (3) Little or no wind. (4) Clear skies, although fire whirlwinds have occurred under overcast conditions and even at night, clear skies are optimum. Even though fuels will often burn well, less than 10 percent of fire-season days fulfill these conditions in the Upper Midwest.

Pub. Dec. 71: 17p., NTIS No. PB-223 399/7: PC \$2.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Agriculture

5.0046. FIRE SURVEILLANCE SYSTEMS FOR THE DETECTION AND MAPPING OF FIRES

S.N. HIRSCH, U.S. Dept. of Agriculture, Intermtn. For. & Rg. Exp. Stn., Missoula, Montana 59801 (INT2105)

Objective: Develop equipment, methods, and systems for fire detection and mapping.

sociated with small fires. Determine the usefulness of airborne infrared line scanners for the detection of incipient spot fires. Analyze the fire detection systems in use in the National Forests. Study the techniques for employing infrared line scanners on large fire mapping problems.

Progress: Performance specifications for infrared scanners are now available. Methods to transmit infrared imagery from plane to ground are being studied, radiofax components were successful enough in the first trials to encourage us to investigate further. A slide tape on use and performance of a small inexpensive aerial 'fire spotter' was prepared. Heat particulate and gaseous emissions from small fires burning in rotten wood provided data to complement a theoretical and state-of-the-art study to measure such emissions for fire detection purposes.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

5.0047. FIRE ON A FOREST SOIL

D.W. COLE, Univ. of Washington, School of Forestry, Seattle, Washington 98105 (WN700012)

Objective: Study the effect of burning as a process, evaluating both the changing character of the elemental capital and the dynamic nature of elemental movement.

Approach: Evaluate the changes that have developed in the basic organic and mineralogical composition of the soil during and following burning. Determine the pathways and rates of elemental movement in the soil following burning utilizing a tension lysimeter system.

Progress: A system utilizing tension lysimeters has been developed to measure changes in ion transport in the soil of a forest stand subjected to slash burning. The results of this study show that 1. Slash burning causes transfer of large quantities of nutrient elements both to the soil and to the atmosphere. 2. This increase in elemental transfer is related to the fuel load. 3. Elemental loss from the rooting zone is increased up to 450% by burning. 4. Leaching of the ash layer is the major source of mobile elements, heating of the soil has only a temporary effect on elemental mobility. 5. Transport of elements through the soil is related to the solubility of the ash constituents. These results have led to the publication of a paper. In addition, this work has led to the development of an expanded program of fire research in cooperative agreement with the U. S. Forest Service.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

6. FLOODS

INDIVIDUAL ASSISTANCE

6.0001. DISASTER INVESTIGATIONS

C.G. CULFER, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234

Reasons for starting or progress last year: Post disaster investigations conducted last year include: (1) Flood damage following Hurricane Agnes. (2) Managua Earthquake investigation. (3) Collapse of Skyline Towers high-rise apartment building. and (4) Tornado damage in Fairfax County, April 1973.

The Hurricane Agnes investigation led to an NBS project for the Department of Housing and Urban Development in

Nicaraguan government in evaluating the safety of buildings in Managua. A report of this work will be published in the Bulletin of the Seismological Society of America. In addition, CBT is working through the Department of Commerce in assisting with the development of building standards for the reconstruction activities in Managua.

As a result of the initial Skyline Tower investigation, NBS worked on a project for the Occupational Safety and Health Administration to determine whether any OSHA standards had been violated during the construction of the building and if standards violation contributed to the collapse. A final report on this project was submitted to OSHA on June 11, 1973. In addition, an Interagency Agreement between NBS and the Department of Labor related to continuing NBS technical assistance relative to OSHA activities was formalized.

The investigation of tornado damage provided direct input to a project being conducted by CBT for the Defense Civil Preparedness Agency regarding the natural hazards evaluation of existing buildings. Typical failure modes produced by tornadoes were identified and significant building parameters to be evaluated in surveying the hazard potential of existing buildings were developed.

Approach: Investigations will be conducted following the occurrence of significant natural disasters including earthquakes, hurricanes and tornadoes. Surveys of other disasters, such as building collapses, fires, etc., will also be conducted as part of this program. (Text Abridged)

SUPPORTED BY U.S. Dept. of Commerce - N.B.S.

6.0002, THE FEDERAL RESPONSE TO TROPICAL STORM AGNES: A REPORT TO THE SENATE COMMITTEE ON PUBLIC WORKS, SUBCOMMITTEE ON DISASTER RELIEF

UNKNOWN, U.S. Exec. Office of the Pres., Off. of Emergency Preparedness, Washington, District of Columbia 20006

This report covers the activities of the Office of Emergency Preparedness and other Federal agencies in the seven States that were declared major disaster areas as a result of Hurricane Agnes and the ensuing tropical storm. By bringing together in one report the activities of several agencies, the report highlights the coordination that was achieved among local, State, Federal, and voluntary agencies in restoring community services and aiding individuals to recover from the effects of this disaster.

Pub. May 73: 62p., Fed. Disaster Assist. Admin., Dept. of HUD, Wash., D.C.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0003, SILVER VALLEY FLOOD - SOCIAL PSYCHOLOGICAL EFFECTS

C.D. HARVEY, Boise State College, School of Arts, Boise, Idaho 83707

This study would compare reactions of female subjects to a flood in the Silver Valley, Shoshone County, Idaho, with reactions of females to a previous mine disaster in the same community. The flood occurred in January, 1974, forcing evacuation of over 800 families and causing millions of dollars of damage to property. The mine disaster occurred in May, 1972, trapping 93 miners for a week and killing 91 of them. Data were collected in November, 1972, by the principal investigator of this proposal regarding women affected

disaster would be drawn.

Specific objectives include the following: (1) to compare eveneers to non-eveneers in social response to the flood, (2) to analyze emergent norms in the flood as contrasted to the mine disaster, (3) to evaluate effectiveness of aid in both disaster situations, (4) to test theoretical models of family stress, and (5) to evaluate psychological effects of trauma as mediated by locus of control.

Methods would include interviews with 100 eveneers and 100 noneveneers. Part of the schedule would replicate the mine disaster study, including such items as anxiety and negative feelings scales, source and content of initial disaster news, activity during disaster, and assignment of blame. Part of the schedule would include information on evacuation patterns found in other floods; personality information on locus of control and trauma would also be gathered.

Analysis of the data will focus on a comparison of the eveneers to noneveneers in terms of social definitions of the flood and personality influences on trauma, as well as a comparison of social processes in the two disasters.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - A.D.M.H.A.

6.0004, FACTORS AFFECTING RELOCATION IN RESPONSE TO RESERVOIR DEVELOPMENT

R.J. BURDGE, Univ. of Kentucky, Water Resources Institute, Lexington, Kentucky 40506

Abstract: The focus of the paper is on the question of how rural people anticipate forced moves as a result of flood control projects and how they change their life in accepting separation from familiar surroundings. A model of forced migration is presented which sees the variables of socio-economic status, knowledge of reservoir projects, vested interests and the degree of identification with place of affected persons as producing differential apprehension over moving. Differential apprehension is then seen as producing different attitudes toward the project which will influence the type of migration plans. To test this model of forced migration, data were obtained by means of personal interview with 261 adults located in two areas about to be flooded by multipurpose reservoirs. Goodman and Kruskal's gamma was used as the measure of association for the ordinal data.

Pub. 1970: 41p., NTIS No. PB-196 659, PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.I.

6.0005, FLOOD INSURANCE STUDY

C. BARRIENTOS, U.S. Dept. of Commerce, National Weather Service, Silver Spring, Maryland 20910

Technical objective: Determine the extent of inland flooding in response to a storm surge on the open coast. Results will enable the Federal Insurance Administration of HUD to set insurance rates for coastal properties.

Approach: Beginning with the storm surge envelope on the open coast computed by the "SPLASIP" program, past storms are examined for relationships between such storm parameters as size, intensity, motion, etc., and the height of inland inundation. Initially the study will be constrained to flood effects inland from an uninterrupted coastline.

Progress: A mathematical surge inundation model for an open broken coast has been developed and applied to the Charleston, S.C., area and the west coast of Florida to assess flood potential.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0006, FLOOD INSURANCE STUDY

D. FEIT, U.S. Dept. of Commerce, Techniques Development Lab., Silver Spring, Maryland 20910 (R3427200)

Technical objective: Determine the extent of inland flooding in response to a storm surge on the open coast. Results will enable the Federal Insurance Administration of HUD to set insurance rates for coastal properties.

Approach: Beginning with the storm surge envelope on the open coast computed by the SPLASH program, past storms are examined for relationships between such storm parameters as size, intensity, motion, etc., and the height of inland inundation. Initially the study will be constrained to flood effects inland from an uninterrupted coastline.

Progress: After sufficient data was collected, work began on development of a mathematical model to handle inundation from storm surge at an unbroken coastline.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0007, CASE STUDY OF ECONOMIC ASPECTS OF THE FEDERAL FLOOD INSURANCE PROGRAM

L.R. CHEATHAM, Mississippi St. University, Graduate School, State College, Mississippi 39762

The objective of the study is to determine the impact of flood insurance on flood plain use and development, by means of a case study. Businessmen and realtors in the case study area will be surveyed for the purpose of acquiring information relative to the impact of availability of flood insurance on capital expenditure decisions and on property values. Flood plain use in the area will be evaluated in terms of economic impact on a municipality and in terms of the Federal Flood Insurance Program purposes.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0008, MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN CENTRAL REGION, COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, State Dept. of Pub. Welfare, Camp Hill, Pennsylvania 17011 (HSM-42-73-27)

The Contractor shall provide mental health services to the residents of flood disaster areas in Central Region, Commonwealth of Pennsylvania. Specifically, the Contractor shall: 1. Provide direct services to alleviate identified mental health disabilities and to prevent the development of overt mental health problems. In addition, other human resource agencies in the affected areas will be identified so that information and referral can be facilitated when indicated. 2. Develop a program design so that a cadre of human service workers can be deployed to provide the maximum contact with those groups in the affected communities identified as being at high risk for mental disabilities. Such groups shall include the elderly, children, displaced persons and families (including those in mobile home camps), the unemployed, the physically disabled, and those previously identified as emotionally disturbed. The emphasis is to be on a community-based, highly mobile, cadre to have the capability to go where the problems are. 3. Explore all aspects of potential mental health problems so that disabilities can be averted, including suicide prevention, depression, adolescent run-aways, drug

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - H.S.M.H.A

6.0B09, MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN LUZERNE-WYOMING COUNTIES OF THE COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, Hazleton Nanticoke M.H. & M.R., Nanticoke, Pennsylvania 18634 (N01-M11-4-0008)

Independently, and not as an agent of the Government, the Contractor shall furnish all necessary labor, materials and facilities to provide mental health services to the residents of flood disaster areas in Luzerne-Wyoming Counties, Commonwealth of Pennsylvania. Specifically, the Contractor shall: 1. Provide direct services to alleviate identified mental health disabilities and to prevent the development of overt mental health problems. In addition, consultation with other human resource agencies will be continued so that information and referral can be facilitated when indicated. 2. Continue the existing program design developed under Contract No. HSM-42-73-28, so that a cadre of human service workers will be deployed to provide the maximum contact with those groups identified as being at high risk for mental disabilities. Such groups shall include, but not be limited to, the elderly, children, displaced persons and families (including those in mobile home camps), the unemployed, the physically disabled, alcoholics, and those previously identified as emotionally disturbed. The emphasis shall continue to be on a community-based, highly mobile, cadre to have the capability to go where the problems are. 3. Explore all aspects of potential mental health problems so that disabilities can be averted, including suicide prevention, depression, adolescent run-aways, drug abuse, etc. Special programs could be instituted with local support where indicated. 4. Provide primary prevention services by raising the profile of the community mental health centers and making the community members more aware of existing mental health programs and facilities. 5. Provide appropriate human related services to individuals and families in crisis.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - H.S.M.H.A

6.0010, TRAINING AND EVALUATION OF MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, Eastern Penn. Psych. Institute, Philadelphia, Pennsylvania 19129 (HSM-42-73-29)

The Contractor shall plan, develop and implement a mental health training program for human services aides to deliver services to the recent flood victims of the Commonwealth of Pennsylvania and to provide for an evaluation of the training and services relevant to the delivery of mental health services: 1. Human Services Aides Training Program - The Contractor shall plan, develop and implement a mental health training program for human services aides to deliver services to the recent flood victims of the Commonwealth of Pennsylvania. The Contractor shall: a. Search literature regarding crisis intervention for implications for training in the evaluation and meeting of flood and disaster victims' needs. b. Determine the specific problems and needs of the affected

ing program. d. Establish the numbers and characteristics desired of individuals to be trained with particular emphasis on utilization of indigenous, nonprofessional people. e. Develop a suitable training program which will initially train as large a number of persons as possible in a relatively brief period of time (i.e. 5 to 6 days) so as to be able to begin providing services shortly thereafter. 2. Evaluation of Training and Services - The Contractor shall provide for an evaluation of the training and services to determine the effectiveness of the training and services relevant to the delivery of mental health services. The evaluation of both training and services will be concerned with three areas, namely structure, process and outcome.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - H.S.M.I.A

6.0011, MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN LUZERNE-WYOMING COUNTIES, COMMONWEALTH OF PENNSYLVANIA

UNKNOWN, Luzerne Wyoming Co. M.H. Prog., Wilkes Barre, Pennsylvania 18702 (HSM-42-73-28)

The Contractor shall provide mental health services to the residents of flood disaster areas in Luzerne-Wyoming Counties, Commonwealth of Pennsylvania. Specifically, the Contractor shall: 1. Provide direct services to alleviate identified mental health disabilities and to prevent the development of overt mental health problems. In addition, other human resource agencies in the affected areas will be identified so that information and referral can be facilitated when indicated. 2. Develop a program design so that a cadre of human service workers can be deployed to provide the maximum contact with those groups in the affected communities identified as being at high risk for mental disabilities. Such groups shall include the elderly, children, displaced persons and families (including those in mobile home camps), the unemployed, the physically disabled, and those previously identified as emotionally disturbed. The emphasis is to be on a community-based, highly mobile, cadre to have the capability to go where the problems are. 3. Explore all aspects of potential mental health problems so that disabilities can be averted, including suicide prevention, depression, adolescent run-aways, drug abuse, etc. Special programs could be instituted with local support where indicated. 4. In performing the above, the Contractor shall utilize a cadre of 50 indigenous human service workers, at the para-professional level, to be recruited and trained to perform such outreach services as will be determined specifically when the need is fully assessed.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - H.S.M.I.A

6.0012, PROCEEDINGS - COMMUNITY WORKSHOP ON FLOOD INSURANCE

J.E. HACKETT, Virginia Polytechnic Institute, Water Resources Research Ctr., Blacksburg, Virginia 24061

Abstract: Contents: The flood insurance program and the community; Needs for flood preparedness; The meaning of the flood insurance program to the state, the community, and the individual; The flood insurance program from an administrative and financing standpoint; Information needs of the regular program and the emergency program; Corps of engineers

Pub. Aug. 71: 175p., NTIS No. PB-203 739; PC \$3.00 MF \$0.95.

SUPPORTED BY Virginia Polytechnic Inst. - Blacksburg

6.0013, EVALUATION OF FLOOD INSURANCE IN A DISASTER AREA

U.R. WALKER, Virginia Polytechnic Institute, Graduate School, Blacksburg, Virginia 24061

The first part of the study will be devoted to compiling flood damage data from the various sources. A certain amount of reconciliation will be necessary to insure completeness without duplication.

A computer analysis will be developed to assess the costs and the payouts for various levels of coverage.

An effort will be made to assess the rate of recovery, with and without insurance. The source of funds provided the community for recovery will be identified. The impact on the locality and the state when all of the direct costs of flooding are shifted from a general responsibility to an insurance concept will be examined.

Once a city or town qualifies for insurance by adopting certain land use practices, it is still a private market operation to provide insurance coverage. Would a high percentage of coverage on an involuntary basis be required to make insurance practical is a question to be investigated in the light of this disaster. Although the risks are spread over a much larger population than the study area, some indication of trend might be evident as to whether private insurance can ever become a reality or whether subsidized premiums is a more efficient means of allocating the cost of recovery.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr Res. Recl.

6.0014, DELIVERING VOCATIONAL REHABILITATION SERVICES IN A DISASTER AREA

H.R. PHELPS, State Div. of Voc. Reclab., Chatham, West Virginia

Abstract: The principal objective of this project was to respond immediately to the sudden and drastic increase in the need for vocational rehabilitation services precipitated by a major flood disaster. The focus was on delivering vocational rehabilitation services to eligible handicapped individuals in the disaster area. In addition, the project was utilized to permit information and experience needed to plan the role of the state vocational rehabilitation agency in disaster situations.

Pub. Jan. 73: 14p., NTIS No. PB-222 775/9; PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel.

PUBLIC ASSISTANCE

6.0015, ANALYSIS OF COAL REFUSE DAM FAILURE MIDDLE FORK BUFFALO CREEK, SAUNDERS, WEST VIRGINIA - VOLUME I

UNKNOWN, W.A. Wahler & Associates, Palo Alto, California 94303

Abstract: On February 26, 1972, a coal refuse dam, owned and operated by the Buffalo Mining Company, failed near Saunders, W. Va. The resulting flooding of the Buffalo Creek Valley had national ramifications. The immediate consequences

gineers and the U.S. Geological Survey undertook limited field and laboratory testing. These original investigations contributed to an understanding of the Buffalo Creek Flood. The study presents a comprehensive view of the failure with essential data integrated from many sources, and an analysis of the failure based on a thorough program of subsurface exploration and sampling, field and laboratory testing, and engineering analyses.

Pub. Feb. 73: 286p., NTIS No. PB-215 142/1 PC \$6.75 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Bureau of Mines

6.0016, A STATISTICAL SUMMARY OF THE CAUSE AND COST OF BRIDGE FAILURES

F.F. CHANG, Fed. City College, Graduate School, Washington, District of Columbia 20001

Abstract: The report presents a statistical summary of the cause and cost of bridge failures based only on a review of damage reports in the FHWA Emergency Relief files for major floods that have occurred during the last few years. As was anticipated, these reports yielded very limited reliable data, so the dollar projections must be viewed accordingly. The general trends, however, should serve as guideline for future research in related areas. Of 383 cases, 14.9 percent reported damages to the superstructure, 24.5 percent to the pier, and 71.8 percent to the abutment; in 43.2 percent of the cases, the damage extended to the approach roads. In 341 cases where the causes of failure were either stated in the original files or theorized by the reporter, only 6.9 percent of the failures were attributed to riverbed changes (aggradation and degradation), 29.6 percent were attributed to vigorous change in flow, 38.8 percent to flowpath deficiency, 20 percent to floating debris, and only 4.7 percent to structural deficiency.

Pub. Sep. 73: 47p., NTIS No. PB-224 091/9: PC \$3.00 MF \$1.45.

SUPPORTED BY No Formal Support Reported

6.0017, UPPER MISSISSIPPI RIVER COMPREHENSIVE BASIN STUDY - VOLUME V, APPENDIX I - FLOOD CONTROL.

UNKNOWN, Upper Miss. Riv. Comp. Comm., Chicago, Illinois

Abstract: The analysis of floods, flood damage and criteria for flood plain development and flood control programs is given for the Basin, based on an evaluation of geographic, hydrologic and economic factors of flood plain use and development, corresponding average annual flood damages and projections of increased flood plain value, technological research, and information essential to an action program for flood control. Waterborne commerce is directly related to the investments of private industry in terminal and transport equipment and the improvement in the design and operation of the equipment. The commercial navigation needs in the Basin were determined by an analysis of existing and future waterborne commerce on the Upper Mississippi River System. Nine commodity groupings were used.

Pub. 1970: 369p., NTIS No. AD-730 113: MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0018, URBAN GROWTH, RUNOFF, EXTERNALITIES, AND INCOME DISTRIBUTION EFFECTS IN RALSTON CREEK WATERSHEDS

Although urban growth is generally guided by land use zoning with the intent of preventing negative externalities, urban growth may alter the frequency and magnitude of flooding and generate negative externalities.

The specific objectives of this research are to: 1. Determine the impact of urbanization upon flooding frequency and magnitude and to determine watershed hydrological response as a function of urbanization parameters. 2. To delineate flood hazards attributable to urbanization and to predict increased flood hazards. 3. Questionnaire survey of residents and property owners along Ralston Creek will be taken. Estimation will be made of recent flood damages and changes in property values as a result of changes in flood hazard. 4. To determine the income distribution effects associated with the negative externality of urban growth, increased runoff, flood damage, and changes in property values to residents. 5. To analyze the efficiency of the property market over time to determine the effect of increased flood hazard on property values.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Reh.

6.0019, THE GENERATION OF FLOOD DAMAGE TIME SEQUENCES

J.P. BREADEN, Univ. of Kentucky, Water Resources Institute, Lexington, Kentucky 40506

Abstract: There is a need in water resources planning to develop a procedure for determining the time pattern in which flood damages occur as a function of the rise and fall of the flood hydrograph. The widely-used approach for estimation of flood damages does not take into account the fact that the frequency of the annual flood peak may not be the same as the frequency of the total annual flood control storage or for estimating the average annual damages for use in formulation of alternative flood control schemes.

Pub. 1973: 159p., NTIS No. PB-227 216/9: PC \$5.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0020, FLOOD OF JULY 17, 1972 IN GALLUP, NEW MEXICO

L.A. WAITE, U.S. Dept. of the Interior, Geological Survey, Albuquerque, New Mexico 87106

Abstract: On July 17, 1972 severe flooding occurred in Gallup, N.M. An isolated storm approximately nine miles east of Gallup covering 20 of the 558 square miles drained by the Puerco River was responsible. Floodwaters reached a peak gage height of 15.3 feet and peak discharge of 1200 cubic feet per second at the crest-stage gage located on the Puerco River in Gallup. Floodwaters damaged 120 residences, 48 businesses, and 11 public buildings and facilities. Total damages were estimated at \$1,293,000. Gallup was declared a disaster area by Governor Bruce King on July 20, 1972 and by President Richard Nixon on August 1, 1972.

Pub. Oct. 73: 9., NTIS No. PB-225 031/4: PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0021, METEOROLOGICAL AND HYDROLOGICAL ANALYSIS OF THE AUGUST 27-28, 1971, NEW JERSEY FLOOD

H.S. GROPER, U.S. Dept. of Commerce, Weather Bureau, Garden City, New York 11530

Abstract: The paper describes the meteorological patterns that

6.0022.

rainfalls in New Jersey indicates that occurrences of very heavy rains are frequently associated with tropical disturbances. Flood damages, fatalities, warnings issued and areas of record river stages are summarized.

Pub. 1972. 15p., NTIS No. COM-73-10257: Reprint.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0022. THE METEOROLOGICAL AND HYDROLOGICAL ASPECTS OF THE MAY 1968 NEW JERSEY FLOODS

A.S. KACHIC, U.S. Dept. of Commerce, Weather Bureau, Garden City, New York 11530

Abstract: Contents: Meteorological conditions; hydrologic conditions; (Precipitation analysis, River stages; Flood damages, Warnings issued; Casualties).

Pub. Jul 70. 42p., NTIS No. PB-194 222: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0023. FLOOD FREQUENCY AND HIGH-FLOW STUDIES

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Raleigh, North Carolina 27607

There is a need to improve existing flood-frequency reports by updating, using recently developed techniques. There is also a need to determine flood data and hydraulic properties applicable to specific sites. Such studies are needed at sites of bridges, water-supply dams and water-treatment plants, waste-treatment plants, streets, and at other points where flood crests occur.

(a) Update areal flood relationships as sufficient additional data and new techniques become available to significantly improve the accuracy of estimates of flood peaks. (b) Determine the hydraulic properties of specified stream sites or reaches. (c) Immediately following large floods, prepare reports describing the intensity and amount of rainfall, the resulting height, duration, extent and discharge of flooding, and damage.

(a) Statistically analyze annual peak discharges to determine the relation between recurrence intervals and peaks. Use multiple correlation, hydrographic analysis, and modelling techniques to develop areal relationships by which floods of specified recurrence intervals can be estimated from basin characteristics. (b) Use slope-conveyance and step-backwater studies to determine the hydraulic properties of sites or reaches. (c) Assemble available data and prepare short summary reports on intense floods. In case of very rare and intense floods, collect additional data such as peak discharge at miscellaneous sites, bucket surveys of rainfall, flood profiles, or damage surveys.

Areal and site flood magnitudes and frequencies were developed or updated using available reports and more-recent flood-peak data collected. Analyses and studies during the year were directed mostly toward meeting requests for flood data and study of hydraulic characteristics of highway bridge openings. Manuscript reports on floods in the state were prepared for insertion in the annual water-supply paper on floods.

Project will be continued. Special reports will be prepared to describe extreme floods should they occur.

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev. Disaster Rec. Off., Scranton, Pennsylvania

Abstract: Subsequent to the President's Declaration of the Major Disaster Area June, 1972, in the aftermath of Tropical Storm Agnes, the Department of Housing and Urban Development (HUD) earmarked funds for disaster recovery in the State of Pennsylvania. The project involves the principal activities of property acquisition, relocation assistance, demolition, rehabilitation, replanting, provision of new streets and other public improvements, and preparation of land for resale to private developers. Environmental impacts and adverse effects are discussed.

Pub. Jun 73. 83p., NTIS No. FIS-PA-73-1085-D: PC \$6.25

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0025. MODEL CITIES ONE - URBAN RENEWAL PROJECT, READING, PENNSYLVANIA

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev. Disaster Rec. Off., Scranton, Pennsylvania

Abstract: Reading was one of many cities in the Northeast region that was flooded as a result of Hurricane Agnes in the summer of 1972. One area that was flooded has been designed as the Schuylkill Urban Renewal Project. The Riverfront Urban Renewal Project, also flooded, had been in execution for several years. The area east of the Riverfront Project was also flooded. It is part of the Reading Model Cities area. Those portions of the Model Cities area that were flooded were drawn into a flood disaster urban renewal project designated as Model Cities One. It is discussed in the Statement.

Pub. Jun 73. 36p., NTIS No. FIS-PA-73-1082-D: PC \$4.00

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0026. PENNSYLVANIA URBAN RENEWAL PROJECT, HARRISBURG, PENNSYLVANIA, HUD PROJECT NO. R-634C

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev. Disaster Rec. Off., Scranton, Pennsylvania

Abstract: The statement involves the approval and funding of an urban renewal program in Harrisburg, Pennsylvania. The project will be administered by the Redevelopment Authority of Harrisburg and the activities that will be carried out are enumerated. There are no major items of an adverse nature that would preclude the approval of the plan as represented in the draft EIS.

Pub. Oct. 73. 148p., NTIS No. FIS-PA-73-1634-F: PC \$9.50 MF \$1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0027. MILTON SOUTH, MILTON NORTH AND HARBOR TOWNSHIP DISASTER, URBAN RENEWAL PROJECTS, PENNSYLVANIA

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Special Recovery Office, Scranton, Pennsylvania

Abstract: The activities proposed in the three projects include all aspects of urban renewal, including acquisition, relocation, demolition, rehabilitation, replanting, provision of new streets and other public improvements, and preparation of land for resale to private developers.

ject proposes primarily rehabilitation of existing structures in accordance with the requirements of the flood ordinance. The project in South Milton proposes the removal of disaster affected residential premises with a proposed reuse of minimum residential and an expanded industrial complex with additional parking areas and recreational activities. All of the projects and reuses are considered as reasonable accommodations between the hazards of reconstruction in flood prone areas and complete abandonment of the flood stricken community. They provide the most essential improvement on a cost benefit basis. The abandonment of the flooded areas and complete community relocation is not economically feasible and the cost would be prohibitive. Environmental impacts and adverse environmental effects are discussed.

Pub. Oct. 73: 101p., NTIS No. EIS-PA-73-1685-F: PC \$7.25 MF \$1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0028, DOWNTOWN URBAN RENEWAL PROJECT, WILKES-BARRE, PENNSYLVANIA

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Special Recovery Office, Scranton, Pennsylvania

Abstract: The proposed downtown urban renewal project is in the presidentially proclaimed major disaster area resulting from tropical storm Agnes in June 1972. The project site of 207.73 acres, is the commercial center or downtown area of Wilkes-Barre. This area will be rebuilt by (1) removing flood damaged and structurally substandard structures, (2) restoring and improving public facilities, (3) improve traffic circulation, (4) improving and beautifying open space and parks, (5) providing better pedestrian movement and amenities, (6) strengthening residential uses in the northeast corner of the project and (7) anchoring commercial development in the downtown area. Environmental effects are described.

Pub. Nov. 73: 92p., NTIS No. EIS-PA-73-1751-F: PC \$6.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0029, KINGSTON DISASTER URBAN RENEWAL PROJECT, BOROUGH OF KINGSTON, LUZERNE COUNTY, PENNSYLVANIA, HUD PROJECT NO. R-615C

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Comm. Dev. Disaster Rec. Off., Scranton, Pennsylvania

Abstract: The Kingston urban renewal project is a disaster area caused by hurricane Agnes in June 1972. Primary objectives of the project are to remove flood damaged and structurally substandard structures, restore public facilities and services such as street repair, and storm and sewage drainage, rehabilitate flood damaged residential dwellings and commercial properties, and realign certain streets to discourage use of residential streets as thoroughfares. The project will have a very positive long term impact on the environment. No important adverse effects are expected.

Pub. Oct. 73: 113p., NTIS No. EIS-PA-73-1632-F: PC \$7.75 MF \$1.45.

Abstract: During analysis of ERTS-1 imagery for land use patterns a large impoundment of water was observed in a location that was normally farmland. Subsequent investigation revealed that the satellite had recorded the remaining floodwaters from a severe local rainstorm that had occurred four days prior to the overpass. The inundated area was measured using the automatic planimeter associated with the signal analysis and dissemination equipment located at the Remote Sensing Institute. The area measurement coupled with estimates of the land use and productivity of the region permitted an estimate of the crop damage loss for the inundated area.

Pub. Mar. 73: 15p., NTIS No. N73-21361: PC \$3.00 MF \$0.95.
SUPPORTED BY U.S. Natl. Aero. & Space Adm.

6.0031, STUDIES IN CONNECTION WITH HYDROLOGIC AND RELATED PHYSICAL PROCESSES IN THE OLYMPUS COVE AREA OF SALT LAKE COUNTY

J.P. RILEY, Utah State University, Utah Ctr. for Wtr. Resour. Res., Logan, Utah 84321

This project involves the application of an urban hydrology model to the Olympus Cove area of Salt Lake County to provide predicted peak flow rates for storms of various recurrence intervals and degrees of urbanization. From the predicted flow rates and urbanization data, flood damage is estimated. Alternatives for reducing flood damage are also suggested. The information will be used by Salt Lake County planners to plan for the safe urbanization of the Olympus Cove area.

SUPPORTED BY Salt Lake County Government - Utah

6.0032, NATURAL DISASTERS OPERATIONS PLANNING FOR SLOWLY DEVELOPING DISASTERS, VOLUME I

A. SACHS, Inst. for Defense Analysis, Arlington, Virginia 22202

Abstract: The paper describes a prototype natural disaster operations plan for slowly developing natural disasters such as hurricanes, floods, or forest fires. An investigation was concerned with the emergency operations of local jurisdictions (municipalities or counties) and of the state pertaining to natural disasters. It considered the interactions among these jurisdictions from the initial organization and training phase through mobilization of local forces and evacuation, to eventual return and rehabilitation of the evacuees.

Pub. Jul. 72: 105p., NTIS No. AD-749 032: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

DISASTER MITIGATION

6.0033, SPEWRELL BLUFF LAKE, FLINT RIVER, GEORGIA

UNKNOWN, U.S. Army, Engineer District, Mobile, Alabama 36601

Abstract: The project will initiate land acquisition and construction of a 211 foot high dam, 2,000 feet long for the purpose of impounding waters of the Flint River to provide flood control, hydroelectric power generation, recreation, and flow

In Alabama, as elsewhere in general, there exists a conspicuous need for flood-frequency information for small watersheds. This information is required for reliable hydraulic design of small drainage structures and for proper flood plain utilization. The urgency of the need precludes the establishment of a long-term data collection program; thus, a method for deriving the flood-frequency information in a shorter time period is required.

The objective of this project is to develop a method for computing flood-frequency information for small watersheds throughout Alabama. It will not be practical to gage more than a small percentage of the large number of potential sites, thus, the method must be applicable to both gaged and ungaged sites.

The project will proceed through three phases. First, define the functional relation between rainfall characteristics and peak flow on the basis of concurrent records of rainfall and runoff at about 60 sites; second, using the rainfall-peak flow relation and long-term records of rainfall synthesize long-term flood-frequency curves for the gaged sites; third, extend the results areally to ungaged basins on a statewide or regional basis utilizing multiple-regression techniques.

Routine data collection was continued at 19 rainfall flood-hydrograph stations and at 20 crest-stage gages. A progress report was completed which included a method for estimating flood characteristics of small watersheds in Alabama and a summary of work accomplished since 1967.

Data collection will be continued at project stations and two new stations will be established.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0035, ELEMENTS OF THE WATER RESOURCES SITUATION IN ALABAMA

D.B. KNOWLES, State Geol. Survey, University, Alabama 35486

Abstract: The water-resources situation in Alabama has many facets ranging from water supply to waste disposal, from floods to droughts, and from navigation to recreation. Within this wide range of topics two common elements have been selected for consideration in this administrative report--all are intimately related to the hydrologic cycle, and all involve significant areas wherein the knowledge and data are inadequate. Accordingly there is first presented a discussion of the hydrologic cycle to provide a background of understanding. This is followed by a discussion of the types of data and studies that are required for a better understanding of the many problems that face those who seek finite answers in one or more of the facets of Alabama's water-resources situation with recommendations for needed supplemental or additional studies.

Pub. Aug. 70: 31p., NTIS No. PB-214 181/0: PC \$3.75 MF \$0.95.

SUPPORTED BY No Formal Support Reported

6.0036, WORTH OF HYDROLOGIC DATA FOR SHORT-TERM FORECASTS OF FLOODS

M. SNIEDOVICH, Univ. of Arizona, Graduate School, Tucson, Arizona 85721

Abstract: A methodology is developed for the evaluation of the worth of the hydrologic data for short-term forecasts of floods. The effectiveness of the forecasts is measured in

warning time, forecast error, response of the population, and hydrometric network on the end product of the system--that is, the social and economic improvement of the flood plain. An adequate evaluation, especially concerning the potential worth of the hydrologic data, requires a multi-disciplinary study involving hydrologists, economists, sociologists, psychologists and flood plain authorities. In the light of continuous improvement in the scientific and technologic aspects involved in the forecasting system there is a need for a continuous reevaluation of the forecasting system as a potential alternative in flood control projects especially as a complementary alternative to the classical ones such as zoning and structures.

Pub. Jan. 73: 100p., NTIS No. CDM 73-117791: PC \$7.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

6.0037, HYDROLOGIC ENGINEERING METHODS FOR WATER RESOURCES DEVELOPMENT - VOLUME I - REQUIREMENTS AND GENERAL PROCEDURES

L.R. BEARD, U.S. Army, Hydrologic Engineering Center, Davis, California 95616

Abstract: The volume is the first of a projected 12 volume report entitled, 'Hydrologic Engineering Methods for Water Resources Development'. The report is being prepared by The Hydrologic Engineering Center as part of the U.S. Army Corps of Engineers participation in the International Hydrological Decade. Volume I describes the general nature of water resources improvements and the general procedures used in hydrologic engineering studies. The types of water resources improvements covered in this volume include local flood protection, flood control by reservoirs, water supply by reservoirs, hydroelectric power developments, multipurpose reservoirs, and water resource systems. As a part of this volume, three generalized computer program descriptions covering different phases of hydrologic engineering are included.

Pub. Oct. 71: 586p., NTIS No. AD 758 904: PC \$6.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0038, RESERVOIR SYSTEMS ANALYSIS FOR FLOOD CONTROL

H.S. ECHERT, U.S. Army, Hydrologic Engineering Center, Davis, California 95616

The rapid increase in complexity of water resources planning studies that has taken place during the past 20 years has resulted in a need for more comprehensive project analysis.

The ultimate goal of this research project is to develop a methodology that utilizes the capability of the computer to analyze complex systems of water resource projects in order to make adequate evaluations of alternative projects in the degree of detail required to meet desired objectives. This will require economic and social analyses in addition to hydrologic analyses of projects under a wide range of operating conditions.

Developmental work on a flood control system simulation model will be continued. The development of a comprehensive single reservoir simulation model will be undertaken. It is anticipated that the model, when completed, will be suitable for analysis of reservoir operation for both flood control and the full range of water conservation purposes. Work on a

procedure for systematically evaluating and screening alternatives in kind early in the planning process will be initiated.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0039, EFFECTS OF URBAN DEVELOPMENT AND WATER USE ON THE SANTA ANA RIVER, CALIFORNIA

M. P. BUSBY, U.S. Dept. of the Interior, Geological Survey, Garden Grove, California 92643

Urban development and water use in the upper Santa Ana Valley have affected peak flows and total runoff to an undetermined degree. Long-term planning involves data derived from frequency analyses of streamflow characteristics. Hence, an evaluation of the effect of development and use is required to improve the analytical procedures.

A data collection and study program to estimate the effects of urban development and increasing water use on the surface flow regimen of the Santa Ana River at several key gaging stations, including Prado Dam, Riverside Narrows, and 'E' Street near San Bernardino. For peak flows and total runoff, an attempt would be made to reconstruct the historic records of streamflow under present conditions of development and under conditions of development expected by 1990, as stipulated by local planning agencies, including the flood control district, U.S. Army Corps of Engineers, and several municipal water districts and water agencies.

Assembly of all available data related to urban development and changing land and water use in project area. Storm hydrography analyses will be made to develop hydrograph characteristics for periods before, during, and after urbanization. These characteristics will then be related to urban development factors and interpreted to meet project objectives.

Calibration of several hydrograph models started.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0040, ANALYSIS OF COAL REFUSE DAM FAILURE MIDDLE FORK BUFFALO CREEK, SAUNDERS, WEST VIRGINIA - VOLUME II, APPENDICES

UNKNOWN, W.A. Wahler & Associates, Palo Alto, California 94303

Abstract: On February 26, 1972, a coal refuse dam, owned and operated by the Buffalo Mining Company, failed near Saunders, W. Va. The resulting flooding of the Buffalo Creek Valley had national ramifications. The immediate consequences of the flooding were the deaths of 118 persons and 7 reported missing, the loss of over 500 homes, and extensive flood damage to other property in Buffalo Creek Valley. Basic data were gathered during the investigation of the Middle Fork Valley dams and refuse bank above Saunders during field investigations of the site conducted from the end of March through mid-September 1972. The information consisted of field mapping, subsurface exploration and sampling by means of auger drill holes, field density tests, field permeability tests, aerial photography, vane shear tests, and cone penetration tests. Volume II, the appendices, covers these details.

Pub. Feb. 73: 198p., NTIS Nr. PB-215 143/9: PC \$6.00 MF

Objective: Gain understanding of runoff and erosion processes of steep, unstable mountain chaparral watersheds and their contribution to downstream floods and sedimentation. Develop effective land management practices to combat excessive runoff and erosion, as emergency following fires and for long-term environmental stability.

Approach: Excessive post-fire erosion attacked by studying hydrophobic soils, their chemi-physical nature and relationships of measures to counteract them. Long-term environmental stability sought by ecological approach, including study of site potentials. Relationships between storms and floods studied by investigation of processes, and development of estimation techniques through analyses of existing watershed data.

Progress: Soil water repellency is a frequently encountered site factor that can influence the success of various forestry practices. Severe water repellency is usually the result of fire, but humus and its related microorganisms may also produce repellency. Water repellency may induce excessive runoff and erosion in a burned area. Water repellency also affects relations between soil, water and plants. Adverse effects of water repellency can be eliminated by mechanically disrupting the water-repellent barrier. Under some conditions, treating the affected areas with wetting agents may soon be feasible. A survey of water-repellent conditions is desirable for appraisal of a forest site for various cultural practices. A wetting agent was applied by sprinkler irrigation to a burned watershed as an erosion control measure. The wetting agent decreased production of mustard (*Brassica* spp.) and increased production of annual ryegrass (*Lolium* spp.). When the wetting agent was applied, the soil surface was more moist and more favorable for seedling establishment which favored grass over mustard. A laboratory experiment indicated that the wetting agent suppressed production and growth of mustard seedlings and had a less suppressive effect on ryegrass seedlings. The differential phytotoxicity was presumably responsible for much of the difference between grass and mustard seedling establishment in the field.

SUPPORTED BY U.S. Dept. of Agriculture - F.S.

6.0042, SAN GORGONIO PASS, CALIFORNIA GENERAL PLAN TECHNICAL REPORT

UNKNOWN, Council on Intergov. Relations, Sacramento, California 95814

Abstract: A technical supplement to the San Geronio Pass General Plan is presented in relation to such problems as inadequate roadways, flood threat, fear of brush fires, physical damage, and unsightly utilities. It includes elements for physical features, solid and cultural aspects, environmental quality, housing, economics, land use, public facilities and services, circulation and transportation, and government fiscal concerns.

Pub. Aug. 71: 197p., NTIS Nr. PB-210 872: PC \$12.00 MF \$0.95.

SUPPORTED BY Riverside County Govt. - Cal.

6.0043, FLOODS FROM SMALL DRAINAGE AREAS CALIFORNIA

A.O. IVANANEN, State Dept. of Transportation, Sacramento, California 95814 (2R23220113)

6.0044.

homogeneous hydrologic regions. More than 300 crest-gage stages have been established. In addition, continuous water-stage and precipitation-recording gages are installed at a given site for a period long enough to establish the rainfall-runoff relation.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0044, SOUTH COASTAL BASIN PRECIPITATION FREQUENCY - A REGIONAL ANALYSIS OF DEPTH-DURATION FREQUENCY OF SHORT-DURATION PRECIPITATION IN CALIFORNIA

J.D. GOODRIDGE, State Dept. of Water Resources, Sacramento, California 95802

California's South Coastal Basin is the location of the heaviest rainfall intensity in the State. Local agencies of the South Coastal Basin have pioneered in data collection for use in evaluating flooding hazards.

The objectives of this report are: (1) to provide a summary of the records of extreme precipitation and (2) to illustrate a method of using the results of a one-hour extreme annual storm to develop the annual storm for shorter durations.

The information provided here consists of a uniform approach to determining the frequency of precipitation events of various magnitudes. It provides a method for interpolating between weather stations to obtain rainfall values for use in estimating runoff from small watersheds. This analysis will provide the basis for a state-wide study of the frequency of rainfall events for durations of less than one hour.

SUPPORTED BY California State Government - Sacramento

6.0045, URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology, Sacramento, California 95814

Abstract. This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, loss of mineral resources to urbanization, landsliding, flooding, erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of possible loss-reduction measures, and agencies responsible for those measures.

Pub. Jun 73: 111p., NTIS No. PB-222 447/5: PC \$7.75 MF 1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0046, DRAINAGE AND FLOOD CONTROL BACKGROUND AND POLICY STUDY - SAN DIEGO

G.S. NOLTE, San Diego Co. Comp. Plan. Org., San Diego, California

This study identifies the drainage and flood control problems of the San Diego region, as well as provides an up-to-date information on the existing conditions and the needs for flood control

flood control problem; and suggests some seven tentative organizational arrangements for carry control work for the region. Volume II describes CONS, a computerized method for the systematic of urbanization's effects on design and costs of facilities.

The findings of this study are contained in three sections: Volumes I, II, and a Summary Report.

Pub. May 70: NTIS on San Diego Co. Comp. Plan. Org., Co. Admin., 1400 Pacific Highway, San Diego 92101.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0047, INITIAL WATER, SEWERAGE AND FLOOD CONTROL PLAN - SAN DIEGO COUNTY, CALIFORNIA

The Initial Plan Report consists of two reports: A and B. Report A is a technical. The Summary Report presents goals for the provision and extension of water, sewerage, control facilities and service. The Summary Report presents a summary of an evaluation of the adequate present facility systems to meet present and projected needs, as well as a list of proposed projects. Based upon this evaluation, Recommendations for water supply planning, implementation, and governmental organization in this context, is also presented.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0048, FLOOD FREQUENCY IN URBAN AREAS - COLORADO

G.L. DUCRET, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225 (C068-011-C)

This research is part of the program of water investigations conducted by the U.S. Geological Survey in cooperation with State and local agencies in Colorado.

Purpose: To collect data in type areas and develop runoff relations that can be extrapolated to all urban areas in the metropolitan areas of the 6 county area, Denver.

Methods: Rainfall and runoff data will be collected for four drainage basins in the 6 county area. They are selected to sample the following ranges in land use: (a) Size: 40 acres to 10 square miles, (b) Catchment: completely impervious; (c) Drainage: unimproved, sewerage to non-sewered; (d) Development: Non-urbanized, the initial basins being subject to development perhaps 15 years.

Rainfall data will include continuous records of rain at one or more sites in each basin, supplemented by standard rain gages. The runoff data will include records of outflow from each basin, supplemented by crest gages to record peak stages and recessions. Because of the expected rapid changes in the basin, the gages will have a time scale currently record changes during time intervals of minutes.

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey, Water Resources Division in cooperation with Colorado Department of Highways.

Purpose: To collect data and develop techniques for estimating the magnitude and frequency of floods on small watersheds. Emphasis will be on providing the greatest degree of accuracy on watersheds crossing the State Highway network where the information will be of economic significance in the design of hydraulic structures such as bridges and culverts.

Methods: Data for this project will be collected from about 55 new stage-rainfall recorder installations distributed geographically so as to sample typical hydrologic environments. Data from the present streamflow network and from the Weather Bureau's precipitation network in Colo. and adjoining States will be included in the analysis. Fieldwork will consist of reconnaissance trips to select sites, installing gages, servicing recorders, making measurements of flood flows, and determining watershed parameters. Office work will consist of research on technique development and on data processing.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0050. FLOOD PROTECTION AT CULVERT OUTLETS

D.B. SIMONS, Colorado State University, School of Engineering, *Fort Collins, Colorado 80521*

Abstract: Techniques for the design of stable rock-riprap protection in the vicinity of bridge crossings are computed from methods derived in other sources, and the properties are related to particle sizes for riprap protection of abutments and piers. Design steps for prototype bridge crossings are enumerated so that the hydraulic engineer may use this report as a design manual. An example of the design protection for a prototype bridge crossing is included to clarify the suggested design procedures. Riprap-protected spill-through abutments were constructed in the hydraulic facilities at Colorado State University in order to test the validity of the suggested design procedures. The results of this research will become the standard for establishing erosion protection required at bridges.

Pub 1970: 232p., NTIS No. PB-196 972: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0051. A STUDY OF THE OPTIMAL MIX OF PRIVATE AND PUBLIC ACTION FOR LOCAL AND REGIONAL WATER CONSERVATION

R.F. MINNEHAN, Univ. of Delaware, Division of Urban Affairs, *Newark, Delaware 19711*

Abstract: A set of local water resource problems were studied: upstream runoff control and downstream flooding, temporary sewage treatment plants, and choice of a regional waste water handling system. The study focus was on a preliminary test of four hypotheses about the process of design and decision-making. These hypotheses include: That for some situations a combination of privately and publicly constructed and financed conservation measures may be a more efficient choice than public actions alone and that the specific availability of funds and/or financing procedures may distort or bias the choice between alternative water conservation systems. These hypotheses and their application to the case studies are discussed using verbal cost-benefit arguments to show why

COMMISSION BY THE INTERNATIONAL GREAT LAKES LEVELS BOARD

UNKNOWN, Internat. Joint Commission, *Washington, District of Columbia 20440*

The purpose of this study are: (1) to review the various factors affecting the fluctuations of the water levels of the Great Lakes; (2) to determine the feasibility of regulating further the water levels in the Great lakes and connecting channels so as to bring about a more beneficial range of stage and other improvements for the purposes enumerated in the Reference; (3) to determine the changes in existing works or other measures within the basin needed to accomplish such regulation that would be practicable and in the public interest; (4) to provide an estimate of the costs of such measures; and (5) to indicate the probable effects, beneficial or adverse, in each country of any regulation plans or measures proposed. The study considers all major interests affected by the water levels of the Great Lakes.

Pub. Dec. 73: 294p., No copy info. Available.

Abstract provided by FDAA.

SUPPORTED BY No Formal Support Reported

6.0053. CHENA RIVER LAKES PROJECT, ALASKA - PROBLEMS RELATING TO CHANNEL DEVELOPMENT, EROSION, & BANK & LEVEE PROTECTION

C.P. LINDNER, U.S. Army, Corps of Engineers, *Washington, District of Columbia 20310*

Abstract: The report, prepared by the Committee on Channel Stabilization and its consultants, for the U.S. Army Engineer District, Alaska, presents the requested opinions of the Committee concerning channel stabilization problems involved in evaluating the several alternate plans for regulating the Chena and Tanana Rivers to provide protection for the City of Fairbanks, Alaska, from floods.

Pub. Mar. 73: 31p., NTIS No. AD-758 443: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0054. JACKSON HOLE FLOOD CONTROL PROJECT

UNKNOWN, U.S. Army, Corps of Engineers, *Washington, District of Columbia 20310*

Abstract: The report, prepared by the Committee on Channel Stabilization and its consultants, for the U.S. Army Engineer District, Walla Walla, presents the requested opinions of the Committee concerning flood control and channel stabilization improvements on the Snake River in the Jackson Hole, Wyoming, area.

Pub. Mar 74: 18p., NTIS No. AD-777 796/4: PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0055. HURRICANE CREEK WATERSHED PROJECT, HUMPHREYS AND DICKSON COUNTIES, TENNESSEE

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, *Washington, District of Columbia 20250*

Abstract: The project is for watershed protection, flood prevention and municipal water storage in Humphreys and Dickson Counties, Tennessee. The project includes conservation land treatment measures supplemented by seven floodwater re-

6.0056.

roads and bridges 93 percent and flood plain scour damage by 78 percent. In addition, there will be a reduction in inconveniences like closed mails, and reduced suspended sediment in the creek by 16 percent. About 344 new industrial and rural on-farm jobs will be created by the project.

Pub. Sep. 73: 51p., NTIS No. EIS-TN-73-1466-F; PC \$4.75 MF \$1.45

SUPPORTED BY U.S. Dept. of Agriculture

6.0056, BLACK HILLS FLOOD OF JUNE 9, 1972

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

The morning after the disastrous flood swept through the canyons and valleys of the Black Hills of South Dakota, a survey team was dispatched to the devastated area to review the effectiveness of NOAA's warning service and to identify weaknesses that require remedy. This report-The Black Hills Flood of June 9, 1972-presents the findings and recommendations of the Survey Team.

Pub. Aug. 72: 20p., Natural Disaster Survey Rpt. 72-1, U.S. Dept. of Comm., NOAA

Abstract provided by FDAA

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0057, ESSA AND OPERATION FORESIGHT

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

A report on ESSA's performance before and during the heavy floods in the Midwest, March-April 1969, based on a survey of how ESSA's River and Flood Forecast and Warning Service performed during the disastrous flood situation that was occurring in the Midwest. This report is a review of the effectiveness of forecasts and warnings prior to and during the disaster.

Pub. May 69: 44p., ESSA/PI 690030, U.S. Dept. of Comm., ESSA

Abstract provided by FDAA

SUPPORTED BY U.S. Dept. of Commerce - E.S.S.A.

6.0058, FLOOD FLOWS FROM SMALL DRAINAGE AREAS

J.D. CAMP, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242 (2R23007618)

The objective of this study is to provide information that will aid in the scientific design of small drainage structures. The study consists of a field sampling of floods from appropriate areas in Illinois, an analysis of the resultant data, and the development therefrom of information that will permit a more accurate designing of waterway openings for small drainage structures. Crest-stage indicators and water-stage recorders have been installed at a number of sites and periodic observations are being made.

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SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0059, INVESTIGATION AND ANALYSIS OF FLOODS FROM SMALL DRAINAGE AREAS IN OHIO

W.P. CROSS, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242 (2R23012814)

6.0060, INFLOW HYDROGRAPH STUDY - WYOMING

R. CUSHMAN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

The magnitude and frequency of flood volumes to be expected from small drainage areas in Wyoming are to be defined, and also, the characteristic shape of flood hydrographs in relation to the physical characteristics of the basins. A rational method of accounting for the effect of embankment storage which will be useful in culvert design is to be developed. Hydrologic data (stream flow and precipitation) will be obtained for about 50 different basins. Data on stream length, slope, stream density, size of drainage basin, soil type, basin shape, and other factors will be compiled for each basin. Aerial photographs were adequate, or standard surveying methods, if necessary, on small drainage basins will be utilized. The feasibility of using climatic data to extend by time flood records for a basin will be investigated, and also, the relation between rainfall frequency and runoff volume frequency. Assuming that rainfall frequency is defined by long term records and that general rainfall-runoff volume relations can be defined by the data obtained in this investigation, the frequency of flood peaks can be approached through time lag characteristics. The chosen approach to definition of the effect of embankment storage in reducing flood peaks requires definition of the time lag characteristics of the basin and the relation between outflow and storage at the culvert size. Time lag characteristics are being defined for each of the 50 basins as both rainfall and the flood hydrograph are being measured. Time lags are then related to the physical characteristics of the basin such as length and slope to provide a general method to be used in design. Data on stream length, slope, stream density, size of drainage basin, soil type, basin shape, and other factors are being compiled for each basin.

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SUPPORTED BY U.S. Dept. of Transportation - FHWA

6.0061, PROGRAM FOR HYDROLOGIC INVESTIGATION OF SMALL DRAINAGE AREAS IN TEXAS

E.E. SCHROEDER, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242 (2R23012814)

Hydrologic data, which can be used in the hydraulic design of highway drainage structures, is being obtained and analyzed. The magnitude and frequency of floods in drainage areas ranging from one to 20 square miles are being determined. There will be a minimum of about 150 flood hydrograph recording stations. Texas has been divided into 18 hydrologic regions for large basins. The small basin gage sites will be selected to insure adequate sampling of flood discharges in each hydrologic region, giving consideration to surface geology, physiographic & topographic features and other factors.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - FHWA

6.0062, FLOW REGULATION EFFECTS OF THE BURLINGTON RESERVOIR FROM THE DAM DOWNSTREAM TO WEST HOPE, NORTH DAKOTA

J.O. SHEARMAN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Prolonged drawdown releases from Burlington Dam, an authorized Corps Of Engineers project on the Souris River in

be made at long-term gaging stations near Bantry and Westhope, N. Dakota.

Reservoir releases furnished by the St. Paul District Corps Of Engineers will be routed downstream and combined with observed tributary inflows. A daily streamflow routing technique based on the continuity principle will be used to route and combine flows.

Developed flow routing model for Souris River below Burlington Reservoir. Using release rates to 300 cfs and 500 cfs, the 1969 flood and estimated 50, 100, and 150 year recurrence interval floods were routed through the model to determine flow characteristics downstream. Computations furnished to Corps Of Engineers.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0063, FLOOD CHARACTERISTICS OF SMALL DRAINAGE AREAS, IDAHO

C.A. THOMAS, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242 (2R23082864)

Flood frequency, magnitude and hydrologic characteristics of small drainage areas are being determined in Idaho.

Document provided to SSIE by the Highway Research Information Service.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0064, COLLECTION AND ANALYSIS OF STREAM FLOW AND RELATED HYDRAULIC DATA FOR DESIGN OF HIGHWAY BRIDGES AND CULVERTS - IOWA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

All data regarding stream flow and floods on streams in Iowa are being collected and analyzed. Peak discharges are determined at gaging stations and frequencies of the peak elevation of the water surface are determined at various points along streams.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY Iowa State Government - Des Moines

6.0065, FLOOD FREQUENCY IN SMALL DRAINAGE AREAS - MISSISSIPPI

K.P. WILSON, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

The flood-discharge frequency relations are being determined for streams draining five square miles or less in the state of Mississippi.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0066, AN OPTIMUM WATER ALLOCATION MODEL BASED ON AN ANALYSIS FOR THE KISSIMMEE RIVER BASIN - FLORIDA

J.E. REYNOLDS, Univ. of Florida, School of Agriculture, Gainesville, Florida 32601

The operating procedures for many multipurpose water management systems are prescribed by operating rule curves which were developed with flood control as their single purpose. Operation by such rigid rule curves often result in less than optimum allocation of water.

The purpose of this study is to develop and empirically test a model for determining the optimal temporal allocation of

activities h. Physical, political and institutional restrictions on water use. c. Allocation between and within watersheds. d. Allocation between time periods. 2. Empirically testing the model in the Kissimmee River Basin: a. Develop homogeneous soil classes based on their response to supplemental water. b. Estimate the value of water in the alternative uses. c. Estimate rainfall, runoff, stream flows, seepage, evaporation and irrigation return flows. d. Determine physical, political and institutional restrictions. e. Apply data to model and determine optimum allocation. 3. Alter the restrictions on water use to determine the effect on the optimum allocation of water. 4. Compare advantages and disadvantages of linear programming and simulation models for water management systems.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0067, HYDROLOGIC AND BIOLOGIC STUDIES OF SOUTHWEST FLORIDA (BIG CYPRESS)

H. KLEIN, U.S. Dept. of the Interior, Geological Survey, Miami, Florida 33130

Changes in hydrology and biology brought on by rapid urbanization in western Big Cypress Swamp are of concern to planning and water supply agencies, because an eastward extension of urban growth could affect not only the adequacy of future supplies but also the ecosystem of the Big Cypress and the northwestern part of Everglades National Park. Agencies must develop policies based on knowledge of the environment so that water resources can be protected and damage to the environment be minimized.

Determine changes in the environment that have taken place as a result of urbanization in the western part of basin and apply knowledge to development of eastern part. Describe alternative methods of flood protection, developing water supplies, controlling pollution.

Determine areas of high yield and water quality in shallow aquifer through test drilling. Prepare series of water level maps to determine recharge areas. Prepare maps of flow distribution, areas of inundation, areas affected by sea-water intrusion, and areas of inferior water quality.

1) Vegetation map prepared for all but western part of Big Cypress. 2) A land use map of Big Cypress, prepared from 1970 aerial photos showed 2,000 of the total 2450 sq. miles was undeveloped; 200 sq. miles was agricultural; and 205 sq. miles was residential or proposed residential. 3) A fairly thick, permeable aquifer in central Big Cypress probably has the potential of serving the foreseeable future municipal water demands for the lower Gulf Coast. 4) Surface runoff ranged from 3500 CFS, November 1969 to zero, during the 1971 drought.

Monitoring 9 ponds, sloughs, canals for complete water quality near sites of proposed oil well drilling to be continued.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0068, RESPONSE OF WATER LEVELS TO FLOOD CONTROL OPERATIONS IN SOUTHEASTERN FLORIDA

H.A. PITT, U.S. Dept. of the Interior, Geological Survey, Miami, Florida 33130

The permeability of the Biscayne Aquifer and the degree of interconnection between the aquifer and the canals are major hydrologic factors in flood control in Southeastern Florida. Canal-aquifer interconnection is excellent in Oade County, but it becomes progressively poor in Broward County where the upper part of the aquifer contains fine materials of low permeability. Because of the different hydrologic charac-

6.0069.

teristics, operation of control structures in canals in areas of good interconnection will be different from the operations where interconnection is poor.

Details of the hydrologic characteristics of individual canal basins must be known for optimum management of the water resources. Some basic hydrologic information is available for C-9 (Snake Creek Canal), C-6 (Miami Canal) and C-2 (Snapper Creek Canal) in individual investigative reports. The results of the study will aid in determination of the secondary or tertiary canal drainage required in flood control.

The plan is to investigate and evaluate the response of ground-water levels and canal levels in interior areas to operations of coastal salinity control structures and inland secondary control structures in selected primary canals. Tests will be made in canal systems in three different geologic environments. During the tests water levels will be measured in shallow observation wells at different distances from the primary and/or interconnected secondary canals.

Tests were completed in the Pompano Creek Canal Basin and levels were run to all date points. Analysis of the data for all three tests was completed and a final report was prepared. This completes the effort on this report.

Final report to be reviewed and approved.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0069, HYDROLOGIC BASE FOR WATER MANAGEMENT, DADE COUNTY, FLORIDA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Miami, Florida 33130

Water resources in Southeastern Florida, particularly in Dade County, are becoming increasingly influenced by water-management practices of the Central and Southern Florida flood control district. With the expanding urbanization there is a growing need for fresh water supplies, flood control, and water conservation.

To prepare an annual report summarizing hydrologic conditions in Dade County as urbanization continues at a rapid pace; and to assist local agencies in specific water-management problems.

Basic data are collected under separate projects. These data will be analyzed periodically to determine the effects and the needs of water management in the county. The annual report will contain basic data concerning fluctuations of the water table and discharges of canals. Water-table maps of the county as well as those of the city of Miami's well fields will be shown for comparison with previous conditions. Graphs and maps showing the distribution of saline water will also be included. Specific hydrologic problems will also be investigated and reported upon.

Annual summary was prepared for 1971 and work on the 1972 summary is in progress. Recommendations for new construction to update monitoring networks were made to local cooperators. Effects of the 1971 drought were discussed in the summary report.

Preparation of summary for 1972.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0070, STUDIES OF THE RED ALGAE IN BISCAYNE

found to be very important among the primary and thus to the food chain, in ten years of field and laboratory studies in the Biscayne Bay area of South Florida estuaries, which studies chiefly deal with the macroinvertebrate population. The *Laurencia* community is intimately connected with the ecology of the animals, serving as a primary food source, a refuge and shelter as well as probable food source. However, the *Laurencia* itself has been undertaken to date and nothing is known of its ecology. It is now necessary to determine the growth rates and major ecological factors affecting the occurrence and distribution of *Laurencia*. The study of the and/or disappearance of this genus probably will provide a sensitive indicator of pollution, which, if used in conjunction with animal and intertidal indicators will give early warning criteria for many types of pollution by our estimates.

How information will be applied: *Laurencia* and *Dige* are to be major contributors to the detrital food web in Biscayne Bay-Coral Sound. Data will be used to set safe limits for flood control canal design and outfall for various industrial plants. The organizations expected to use this information are as follows: U.S. Army Corps of Engineers - for dredging and filling; Environmental Protection Agency - industrial outfalls; Dade County Pollution Control outfalls; Florida Power and Light Co. - heat outfalls; Florida Power Corporation - heat effluent; State Board of Control - industrial outfalls; Westinghouse Corporation - desalination plants; Atomic Energy Commission - heat outfalls.

Accomplishments during the past twelve months: 1) Collection of grass community dynamics, 2) Delimitation of plant outfall on grass and algal population, 3) Base line information on ecology of major green macroalgae.

For additional information pertaining to this project contact: Richard G. Butler, Director, Sea Grant Program, University of Miami, Coral Gables, Florida 33146

SUPPORTED BY U.S. Dept. of Commerce - NOAA

6.0071, ESTUARINE HYDROLOGY OF TAMPA BAY, FLORIDA

C.R. GOODWIN, U.S. Dept. of the Interior, Geological Survey, Tampa, Florida

A comprehensive hydrological investigation of Tampa Bay and its immediate surroundings is necessary to assess the probable effects of a proposed channel dredging project on the interconnecting hydraulic, chemical and biological systems in the bay. Unanswered technical questions concerning possible ground-water contamination, modified flow circulation characteristics, and overall environment, as well as operational needs, such as quantity and location of dredged material, justify this project.

The specific objectives of this study are: (1) bathymetry of the bay bottom, (2) determination of the location of bedrock, (3) definition of pollutant sources issuing from the bay and their subsequent distribution, (4) development of a management tool to predict the response of the bay to natural and man-made changes (dredging, filling, the hurricanes, etc.), (5) determination of optimum channel location and slope of disposal sites.

The following techniques will be used to accomplish the objectives: (1) bay bottom mapping by negative bathymetry.

MAJOR DISASTER TYPES

6.0075,

data (velocity, elevation, quality), (5) optimum dredge operation and fill placement determined by using model to test all suggestions.

Fourteen tide gages operating; monthly and quarter QW monitoring programs established; Weather Bureau data being received monthly; bottom contour maps under topographic division review; digital model nearing completion of development period; data reports in preparation; 800 miles of depth data collected along ship channel and other areas.

Completion of stage, QW, seismic data reports; preparation of interpretive report; computation of types and quantity of material proposed to be removed from ship channel; completion of digital model; use of model to predict effects of proposed activities.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0072, ORANGE, SEMINOLE, OSCEOLA COUNTIES - WATER MANAGEMENT

UNKNOWN, East Cent. Florida Reg. Coun., Titusville, Florida

Abstract: The study is designed to guide the future design of an engineering system for flood prevention in Orange, Seminole, and Osceola Counties. Emphasis is placed upon preserving and utilizing natural water flow and water storage patterns wherever possible. Existing engineering studies are reevaluated and suggestions made for future engineering designs. The analysis is carried out for thirty-four (34) watersheds in the three county area.

Pub. Feb. 70: 77p., NTIS No. PB-191 246: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0073, CASE STUDY OF REMEDIAL FLOOD MANAGEMENT IN AN URBAN AREA - PHASE III

L.D. JAMES, Georgia Inst. of Technology, Environmental Resources Center, Atlanta, Georgia 30332 (C-2064)

The proposed research is the third and final phase of a case study of water resources management in an urban area, with special emphasis on flood hazards and flood damage abatement alternatives. Phases I and II were concerned primarily with a review and evaluation of basic hydrologic, economic, and demographic data; a study of legal and institutional constraints on flood management in the case study area; and the development and testing of hydrologic-economic and socio-economic models which will reflect significant characteristics of the study area. Emphasis was and will continue to be placed on generalized research methodology - not on the development of an action program for the 'solution' of the case study problem.

Phase III will be concerned with the refinement and testing of models and analytical procedures developed in the previous phases. Tests will be extended to include comparable watersheds. Additional objectives include the determination of the kind, amount, quality, cost, and relative significance of

The objective of the proposed research is to analyze critically five watershed models with data from four hydrologically dissimilar Georgia watersheds. Over the past decade, several digital computer programs have been written to model the continuous response of a watershed to precipitation and evapotranspiration. Although each model has been applied to several watersheds, in very few cases have different models been applied to the same watersheds for quantitative comparison of results.

These models are important tools in the design and analysis of land-use and water resources control structures. Better methods for the synthesis of design floods for flood control structures, flood plain management, urban drainage, and highway culvert design are needed. The hydrologic effects of urbanization and the effects of urbanization and the effects of forest and range management practice on the water resource are best quantified through the use of watershed simulation models.

Hourly precipitation and daily streamflow and pan evaporation data will be obtained, adjusted, and placed on drum file for eight year periods for four Georgia watersheds. Parameters of the five selected models will be determined using the first four years of data and optimization routines. Four additional years of streamflow will be predicted with each model and compared with measured streamflow.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

6.0075, FLOOD HYDROLOGY ON SMALL DRAINAGE AREAS IN GEORGIA

H.G. GOLDEN, U.S. Dept. of the Interior, Geological Survey, Atlanta, Georgia 30309

Previous and continuing studies have defined the flood magnitude-frequency relationship of streams having drainage areas larger than 20 square miles. Practically no reliable information is available for areas smaller than 20 square miles. Economic, safe design of highway drainage structures must, along with other considerations, be based on a knowledge of the magnitude and frequency of floods. This knowledge can only be attained through collection and analysis of factual data from many representative streams chosen on the basis of areal distribution, drainage area size, and a variety of other parameters which may significantly affect peak rates of flow.

The objective of this investigation is to collect the necessary basic data and to analyze those data to develop relationships which may be used to determine flood-frequency characteristics of any small stream in the state.

Streamflow and rainfall data that are collected from 115 strategically located sites will be used to define various components for a digital-computer model of the rainfall-runoff process. Long-term records of flood peaks will be computed by using weather bureau long-term rainfall records as input to the model. Flood-frequency curves will be defined for each data site. Discharge values corresponding to specific recurrence intervals will be taken from these curves and correlated with significant physical and climatic basin characteristics.

teristics, operation of control structures in canals in areas of good interconnection will be different from the operations where interconnection is poor.

Details of the hydrologic characteristics of individual canal basins must be known for optimum management of the water resources. Some basic hydrologic information is available for C-9 (Snake Creek Canal), C-6 (Miami Canal) and C-2 (Snapper Creek Canal) in individual investigative reports. The results of the study will aid in determination of the secondary or tertiary canal drainage required in flood control.

The plan is to investigate and evaluate the response of ground-water levels and canal levels in interior areas to operations of coastal salinity control structures and inland secondary control structures in selected primary canals. Tests will be made in canal systems in three different geologic environments. During the tests water levels will be measured in shallow observation wells at different distances from the primary and/or interconnected secondary canals.

Tests were completed in the Pompano Creek Canal Basin and levels were run to all date points. Analysis of the data for all three tests was completed and a final report was prepared. This completes the effort on this report.

Final report to be reviewed and approved.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0069, HYDROLOGIC BASE FOR WATER MANAGEMENT, DADE COUNTY, FLORIDA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Miami, Florida 33130

Water resources in Southeastern Florida, particularly in Dade County, are becoming increasingly influenced by water-management practices of the Central and Southern Florida flood control district. With the expanding urbanization there is a growing need for fresh water supplies, flood control, and water conservation.

To prepare an annual report summarizing hydrologic conditions in Dade County as urbanization continues at a record pace; and to assist local agencies in specific water-management problems.

Basic data are collected under separate projects. These data will be analyzed periodically to determine the effects and the needs of water management in the county. The annual report will contain basic data concerning fluctuations of the water table and discharges of canals. Water-table maps of the county as well as those of the city of Miami's well fields will be shown for comparison with previous conditions. Graphs and maps showing the distribution of saline water will also be included. Specific hydrologic problems will also be investigated and reported upon.

Annual summary was prepared for 1971 and work on the 1972 summary is in progress. Recommendations for new construction to update monitoring networks were made to local cooperators. Effects of the 1971 drought were discussed in the summary report.

Preparation of summary for 1972.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0070, STUDIES OF THE RED ALGAE IN BISCAYNE BAY

found to be very important among the primary and thus to the food chain, in ten years of field South Florida estuaries, which studies chiefly the macroinvertebrate population. The *Laurencia* community connected with the ecology of the animal shelter as well as probable food source. However, the *Laurencia* itself has been undertaken to date, nothing is known of its ecology. It is now necessary the growth rates and major ecological factors of occurrence and distribution of *Laurencia*. The and/or disappearance of this genus probably will be a sensitive indicator of pollution, which, if used in conjunction with animal and microalgal indicators will give criteria for many types of pollution in our estuaries.

How information will be applied: *Laurencia* and *Diglossina* to be major contributors to the detrital food web in Biscayne Bay-Card Sound. Data will be used to set safe limits for flood control canal design and operation for various industrial plants. The organizations that use this information are as follows: U.S. Army Corps of Engineers - for dredging and filling; Environmental Protection Agency - industrial outfalls; Dade County Pollution Control Agency - industrial outfalls; Florida Power and Light Co. - heat effluent; State of Florida - industrial outfalls; Westinghouse Corporation - desalination plants; Atomic Energy Commission - heat and heat outfalls.

Accomplishments during the past twelve months: 1) Definition of grass community dynamics; 2) Delineation of plant outfall on grass and algal population; 3) Information on ecology of major green macroalgae.

For additional information pertaining to this project contact: Richard G. Bader, Director, Sea Grant Programs of Miami, Coral Gables, Florida 33146.

SUPPORTED BY U.S. Dept. of Commerce - N.O.

6.0071, ESTUARINE HYDROLOGY OF TAMPA BAY, C.R. GOODWIN, U.S. Dept. of the Interior, Geological Survey, Tampa, Florida

A comprehensive hydrological investigation of Tampa Bay and its immediate surroundings is necessary to assess the possible effects of a proposed channel dredging project on the interacting hydraulic, chemical and biological systems in the bay. Unanswered technical questions include: possible ground-water contamination, modified circulation characteristics, and overall environmental impacts as well as operational needs, such as quantity and location of dredged material, justify this project.

The specific objectives of this study are: (1) bathymetry of the bay bottom, (2) determination of the geology and bedrock, (3) definition of pollutant sources in the bay and their subsequent distribution, (4) development of a management tool to predict the response of the bay to natural and man-made changes (dredging, filling, levees, etc.), (5) determination of optimum channel dimensions, quantity of material to be removed, and optimum location and shape of disposal sites.

The following techniques will be used to accomplish the objectives: (1) bay bottom mapping by negative bathymetry, photography and radar located sonic soundings, (2)

data (velocity, elevation, quality), (5) optimum dredge operation and fill placement determined by using model to test all suggestions.

Fourteen tide gages operating; monthly and quarter QW monitoring programs established; Weather Bureau data being received monthly; bottom contour maps under topographic division review; digital model nearing completion of development period; data reports in preparation; 800 miles of depth data collected along ship channel and other areas.

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Phase III will be concerned with the refinement and testing of models and analytical procedures developed in the previous phases. Tests will be extended to include comparable watersheds. Additional objectives include the determination of the kind, amount, quality, cost, and relative significance of the data needed to make meaningful decisions in an efficient manner. Emphasis will be placed on the development of the techniques and the environment needed to stimulate effective dialogue and collaboration between representatives of the several disciplines involved and between the academic and non-academic participants in the research.

The objective of the proposed research is to analyze critically five watershed models with data from four hydrologically dissimilar Georgia watersheds. Over the past decade, several digital computer programs have been written to model the continuous response of a watershed to precipitation and evapotranspiration. Although each model has been applied to several watersheds, in very few cases have different models been applied to the same watersheds for quantitative comparison of results.

These models are important tools in the design and analysis of land-use and water resources control structures. Better methods for the synthesis of design floods for flood control structures, flood plain management, urban drainage, and highway culvert design are needed. The hydrologic effects of urbanization and the effects of urbanization and the effects of forest and range management practice on the water resource are best quantified through the use of watershed simulation models.

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H.G. GOLDEN, U.S. Dept. of the Interior, Geological Survey, Atlanta, Georgia 30309

Previous and continuing studies have defined the flood magnitude-frequency relationship of streams having drainage areas larger than 20 square miles. Practically no reliable information is available for areas smaller than 20 square miles. Economic, safe design of highway drainage structures must, along with other considerations, be based on a knowledge of the magnitude and frequency of floods. This knowledge can only be attained through collection and analysis of factual data from many representative streams chosen on the basis of areal distribution, drainage area size, and a variety of other parameters which may significantly affect peak rates of flow.

The objective of this investigation is to collect the necessary basic data and to analyze those data to develop relationships which may be used to determine flood-frequency characteristics of any small stream in the state.

Streamflow and rainfall data that are collected from 115 strategically located sites will be used to define various components for a digital-computer model of the rainfall-runoff process. Long-term records of flood peaks will be computed by using weather bureau long-term rainfall records as input to the model. Flood-frequency curves will be defined for each data site. Discharge values corresponding to specific recurrence intervals will be taken from these curves and correlated with significant physical and climatic basin characteristics.

Rainfall and discharge data were collected at about 3-week intervals at 110 gage sites. More than 250 flood events were recorded that are considered usable for calibration of the rainfall-runoff model. The long-term Thomasville-Coolidge and Macon storm rainfall and daily rainfall data were coded for use in a computer disk storage. About 60 percent of

6.0076, URBAN HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII

Y. FOK, Univ. of Hawaii, Water Resources Research Ctr., Honolulu, Hawaii 96822

The problems: The Island of Oahu in the State of Hawaii has experienced a rapid growth in urbanization during the past decade. Therefore, many problems related to urban hydrology have been created such as flood, erosion, sediment deposition and water pollution. Insufficient data available for planning, design and improvement are apparent. Simulations of urban hydrology are most needed.

The objectives: A. Simulation of the urban hydrology for selected urban areas in Oahu. B. Expansion of data collection program to include water quality/sediment, windspeed/sunlight/radiation and soil-moisture in addition to the current rainfall-runoff data collection effort upon the adjoining urban/rural watersheds. C. Establishment of the framework for urban water resources evaluation for subsequent studies.

The procedures: A. To complete the data bank for Kalili watershed for use in watershed simulation models development. B. To implement the research urban/rural watersheds with water quality/sediment, windspeed/sunlight/radiation and soil-moisture measurement devices to provide a relatively complete data collection program for subsequent urban hydrology and water resources studies. C. To establish a framework for urban water resources systems evaluation.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Res.

6.0077, FLOOD HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII

Y.S. FOK, Univ. of Hawaii, Water Resources Research Ctr., Honolulu, Hawaii 96822 (2R23219961)

The objectives are: (1) to gain greater understanding of the island of Oahu, from available flood data, (2) to investigate the effect of urbanization as reflected in changes of flood hydrographs, (3) to initiate studies for urban and natural watershed models specifically suited for Oahu, Hawaii, and (4) to establish guidelines for subsequent studies of urban water resources systems analysis for Oahu, Hawaii.

This project has been funded for a three-year period study. The first phase was completed and a report was published as Technical Report No. 64, Water Resources Research Center, University of Hawaii, March, 1973.

Document provided to S.S.I.E. by the Highway Research Information Service.

SUPPORTED BY University of Hawaii

6.0078, INSTANTANEOUS UNIT HYDROGRAPH ANALYSIS OF HAWAIIAN SMALL WATERSHEDS

R. WANG, Univ. of Hawaii, Water Resources Research Ctr., Honolulu, Hawaii 96822

Abstract. An analysis of 200 flood hydrographs of 29 small watersheds on Oahu show some unique hydrologic characteristics. Many of these watersheds are small, some measuring less than 5 square miles, and they have extreme variations in rainfall. Between 4 and 15 single-peak hydrographs were collected for each watershed. The Instantaneous Unit Hydrograph was more adaptable for ocean island conditions such as the Hawaiian Islands, and each individual watershed could be treated by computers. In analyzing these flood

period. A good correlation was found to exist between five rainfall duration and the watershed area.

Pub. Aug. 70: 56p., NTIS No. PB-204 549. \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.

6.0079, FLOOD INVESTIGATIONS FOR SMALL DRAINAGE BASINS IN IDAHO

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Boise, Idaho 83702

To provide highway design data based on the frequency of floods for small drainage basins (less than 100 sq. mi.) in Idaho.

To collect and compile annual peak discharge data for selected sites throughout Idaho. These data will be analyzed by statistical methods to provide flood magnitude and frequency data on which sound hydraulic design of culverts and small bridges can be made.

Establish, operate, and maintain crest stage gages for sufficient hydrologic data, statewide, upon which statistical analyses of flood magnitudes and frequencies for small drainage basins can be made.

A 10-year data collection phase ended on Sept. 30, 1969. Data collected to that date has been analyzed to determine flood magnitude and frequency relations have been established. The relations are to be published in two reports: a design manual for the Idaho Department of Transportation and will be an administrative report. The second phase of the entire analysis and will be an open-file report.

Complete reports described above and listed below are the data collection effort to provide data in areas of flood magnitude and frequency relations are being established. Continue, as required, special studies in river basins and reviews of environmental impact studies.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0080, A METHODOLOGY STUDY TO DEVELOP CRITERIA FOR EVALUATION OF WILDERNESS RIVERS - REPORT ON FLOOD CONTROL STUDIES IN IDAHO

J.J. PEEBLES, Univ. of Idaho, Water Resources Research Center, Moscow, Idaho 83843

Abstract: The report lists major tributaries to the Snake River and gives monthly and annual records of precipitation and discharge of the Salmon at various points. Apparently, no floods have been caused by rain alone but most are caused by a combination of heavy rain and rain runoff. The history of flooding in the Snake River is recounted and an appendix of 18 maps illustrates the areas probably inundated during the Salmon's worst flood occurred in 1894. Costs of past floods are given for populations of small communities within the Snake River basin. Potential flood control storage sites are given along with costs and benefits.

Pub. Feb. 70: 88p., NTIS No. PB-197 997. \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.

6.0081, WATER RESOURCES AND FLOOD PROTECTION

AWS/DO is OPR for Volume I, which applies to all AWS units. AWS Forms 39 and 39a are prescribed in this volume.

Pub. Oct 71: 28p., NTIS No. AD-732 263; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0082. FLOOD FLOWS FROM SMALL DRAINAGE BASINS IN ILLINOIS

G.W. CURTIS, U.S. Dept. of the Interior, Geological Survey, Champaign, Illinois 61820

A large percentage of costs for highway drainage structures is for culverts. Efficient culvert design requires information on magnitude and frequencies of floods from areas of less than 10 square miles. Such small areas are not covered by the 1954 report 'Floods in Illinois: Magnitude and Frequency.'

To prepare a report which will complement the 1954 Flood-Frequency Report, and which can be used by those charged with highway culvert design. More specifically, to prepare a report presenting methods of estimating magnitude and frequency of floods occurring on drainage areas less than 10 square miles in Illinois.

Gather data for annual flood events from a State-wide network of about 100 crest-stage gages on drainage areas of less than 10 square miles. Gather supplemental hydrographic parameters at each of these sites with a network of 25 rating recorders. Define selected hydrographic, climatic, and basin parameters for each site. Define frequency levels by Log Pearson Type III Analyses. Run multiple regressions using all significant parameters and provide estimating equations for determination of magnitude and frequency of floods at ungaged sites draining less than 10 square miles.

Annual maximum flood data were determined for the network of small-area stations. Precipitation and hydrographic records were collected for 19 of the stations. Analog precipitation and hydrographic records for 250 storm events for 22 stations were processed for use in calibration of the USGS Rainfall-Runoff Model. Long-term rainfall records for one station were provided by U.S. Weather Service to use with the model to generate long-term annual peak discharges.

Calibrate USGS rainfall-runoff model so that annual peak discharges can be generated on the basis of long-term rainfall records. Continue record collection at present level to provide additional input to the rainfall-runoff model and to extend the period of actual annual peak discharges.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0083. DEVELOPMENT OF A FLOOD AND POLLUTION CONTROL PLAN FOR THE CHICAGOLAND AREA - COMPUTER SIMULATION PROGRAMS

D.H. CHURCHILL, Illinois Inst. for Envir. Qlty, Chicago, Illinois

Abstract: Several alternatives have been suggested for solving the waterway flood and pollution problems caused by combined sewer overflows in the Chicago Metropolitan Area. This report describes the evaluation of many of these alternatives with the same computer simulation models of hydrologic and pollution events. The criteria was established that the largest storm period or combination of storm and ground moisture conditions on record should not produce backflow to Lake Michigan when applied to ultimate land use and sewer

6.0084. BACKGROUND SURVEY - SURFACE DRAINAGE PROGRAM, MADISON, ST. CLAIR, MONROE AND RANDOLPH COUNTIES, ILLINOIS

UNKNOWN, Southwestern Ill. Plan. Comm., Collinsville, Illinois 62234

Abstract: The report presents an inventory and description of preliminary findings based upon previously established information related to drainage and flood damage control in Madison, St. Clair, Monroe and Randolph Counties. Preliminary findings include basic information concerning the physical and hydrologic character of the region, and inventory of responsible agencies, and a report on the status of drainage within the major hydrologic units.

Pub. Apr 73: 102p., NTIS No. PB-222 504/3; PC \$7.25 MF \$1.45.

SUPPORTED BY Illinois State Government - Springfield

6.0085. LABORATORY STUDIES OF CONSERVATION AND DRAINAGE STRUCTURES

B.A. JONES, Univ. of Illinois, Agricultural Experiment Sta., Urbana, Illinois 61801 (ILLU-10-0315)

Objective: Investigate performance of soil and water conservation structures by means of hydraulic model studies; study water flow patterns into subsurface drains; and determine causes of failure of certain conservation structures under flood conditions and to study remedial measures for prevention of such failures.

Approach: Several model studies of behavior of drop-inlet structures, and energy losses through these structures have been performed; measuring flumes used in the field, calibrated; tile drainage problems including flow patterns, soil movement and filtering materials, studied. Pilot traversing equipment has been and is being used to study velocity distributions in structures under several flow conditions. A tilting model holding table capable of supporting 40 tons is available for tile or watershed studies or flood flow investigations.

Progress: A paper reporting the results of the study of water drop size and impact velocity on the detachment of soils was revised and is scheduled for publication in volume 14(1971) of the Transactions of ASAE. An initial study to determine the nature of sediment transport in a 4-inch inside diameter corrugated plastic drain tube was completed. Brown sand was separated into 4 size ranges to test the effect of particle diameter on transport. All other factors were kept constant. The sand was inserted onto the drain tube after equilibrium flow conditions were established and observations taken of the nature of the transport action. The study showed that particles 1 to 2 mm in diameter settled in the bottom half of the corrugations. Smaller sized particles moved along the tube because of the turbulence and were eventually carried out of the tube. In a second study, a sediment metering device was constructed and used to determine a relationship between relative sediment load and slope at incipient deposition. A model study was started to determine the characteristics of flow in a livestock oxidation ditch. In a typical oval shaped oxidation ditch the waste solids settle at 2 locations causing anaerobic conditions to develop in a system that is designed to be aerobic. The objective of this study is to improve the hydraulic conditions in the ditch so that set-

The objective of this project is to evaluate the capabilities and limitations of remote sensing as an operational tool for the assessment and prediction of environmental and ecological impacts of flood control reservoirs. The Sangamon River Basin will be monitored before, during, and after the expected construction of the Oakley Reservoir. Data supplied by remote sensors mounted in aircraft and spacecraft (ERTS I and ERTS II and EREP) will be used.

Sponsor's address: Department of the Army, Construction Engineering Research Laboratory, Interstate Research Park, P.O. Box 4005, Champaign, Illinois 61820.

SUPPORTED BY U.S. Dept of Defense - Army

6.0087. DRAINAGE AND FLOOD CONTROL PLAN - MARION COUNTY, INDIANA SEPTEMBER 1970

UNKNOWN, Marion Co. Metro. Dev. Dept., Indianapolis, Indiana

This report is a comprehensive study of watersheds in and entering Marion County. It delineates, describes, measures and classifies each watershed. It inventories and determines the adequacy of all watershed studies previously conducted, and broadly identified needs for future studies. Based upon adequacy of existing studies and needs for future studies, it estimates costs for producing detailed comprehensive drainage and flood control plans for each watershed. The appendix provides detailed stream information. The report includes twelve folded topographic maps in a pocket attached to the rear cover displaying watershed delineation and certain stream information.

Pub. Sept. 70: NTIS on Dept of Metro. Devel., R. 2041 City Co. Bldg. Ind., Ind. 46204.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0088. INITIAL RESULTS FROM THE UPPER WABASH SIMULATION MODEL.

T.P. CHANG, Purdue University, Water Resources Research Ctr., Lafayette, Indiana 47907

Abstract: A recently built simulation model for the Upper Wabash reservoir-river system in Indiana was used to study how best to operate that system. The construction of the model and of the three daily operating policies for it (that presently employed by the Corps of Engineers, the Drainage-Area Ratio and the Storage-Volume Ratio) were outlined in two preceding reports. This report discusses results that were obtained with each of the three policies applied to various reservoir configurations having up to five reservoirs, using a variety of runoff input, and for several alternative values of official flood-stage flows. The DAR and SVR policies were both superior to that used by the Corps when the runoff was less than 10 inches. Results obtained for the addition of a small water supply demand at one reservoir indicated that small changes in the mix of project require careful alteration of the operating policies throughout the system. The major conclusion was that this practical model and its operating policies can be a useful aid to design, planning and regulatory agencies.

Pub. Mar. 73: 99p., NTIS No. PB-219 478/S; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0089. PLANT SPECIES AS WILDLIFE COVER AND

Abstract: This research project was initiated at a natural establishment of plant species in shoreline areas on recently exposed mudflats following the recession of floodwaters in Iowa's large reservoir systems. The most suitable species for establishment as wildlife cover for erosion control. The development of vegetative cover on a relatively stable shoreline in Iowa contrasts sharply with the erosion of reservoir flood pools. The shoreline of the subimpoundment of the Coralville Reservoir is heavily vegetated. This esthetically pleasant area has no soil erosion and provides manageable natural habitat for wildlife. On the other hand, the impact of erosion on the water level of the Coralville Reservoir is strikingly visible. Dead standing trees, spectating the original forest, dominate the upper reaches of the flood pool landscape. Mud and debris characterize the shoreline immediately following the recession of floodwaters.

Pub. Jul 73: 78p., NTIS No. PB-226 347/3; PC \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0090. STREAMFLOW CHARACTERISTICS OF THE R. HEDMAN, U.S. Dept. of the Interior, Geological Survey, Lawrence, Kansas 66044

This research is part of the program of water resource investigations conducted by the U. S. Geological Survey in cooperation with the State of Kansas.

Purpose: To present streamflow data in terms of streamflow for the development of optimum benefit from available water supplies and optimum protection from flood damage.

Methods: Standard statistical and correlative analysis was used to forecast high, low, and base flow at gaging stations on streams. An appraisal of the stream-gaging network was made. Studies of the following are to be included: (1) transmission losses from reservoirs; (2) forecast of likely low flow of streams in the future; (3) river encroachment; (4) regional streamflow; (5) partial duration series of floods; (6) streamflow and basin characteristics; (7) streamflow simulation.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0091. FLOOD INVESTIGATIONS - HIGH FLOOD PROTECTION - KANSAS

H.R. HEIL, U.S. Dept. of the Interior, Geological Survey, Lawrence, Kansas 66044

There is a need to appraise the flood characteristics of streams specifically to permit the most efficient use of Kansas bridges and culverts, but indirectly to appraise the magnitude, frequency and influencing factors of floods for all agencies requiring information.

To appraise the flood characteristics of Kansas streams

A crest-stage gage network, supplemented with a stage gage network, is operated to provide basic data of stream stage from small drainage areas. Similar basic data of stream stage are available from the gaging network. Flood-frequency relations are being determined from data by standard statistical methods. Relations between the information to ungaged sites are being determined by multiple regression analysis using physical and hydrologic characteristics of the basins. Subsequently, characteristics of the basins and of flow from ungaged sites are being determined.

model has been successfully applied to three basins as a step toward better definition of relations for small drainages. One major bridge-site report was completed.

The rainfall-runoff model will be applied to as many as possible of the 14 basins for which data appear to be adequate. Bridge-site reports will be prepared on request.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0092, STREAMFLOW PATTERNS WATERSHED CHARACTERISTICS THROUGH USE OF OPSIT - A SELF CALIBRATING VERSION OF STANFORD WATERSHED MODEL (ABBREV)

L.D. JAMES, Univ. of Kentucky, Water Resources Institute, Lexington, Kentucky 40506

Abstract: More informed selection among alternative flood control measures requires better information on marginal differences in flood hazards associated with marginal differences in tributary watershed characteristics. Hydrologic modeling is the most promising approach to answering this question; however, the use of existing models is hampered by the absence of information correlating model parameters with physical characteristics of the watershed. To deal with this situation, a method was developed for estimating the parameter values for the Stanford Watershed Model which best match recorded with simulated streamflows. Physical characteristics were measured for 17 rural watersheds. Correlations between the characteristics and the parameters were examined. Changes in parameter values with urbanization were also examined. The results were used to study variations in downstream flood peaks and in average annual flood damages associated with various tributary watershed characteristics. The end product is designed to help guide urban development to minimize flood damage and storm drainage cost.

Pub. 1970: 127p., NTIS No. PB-198 444: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0093, FLOOD-FREQUENCY STUDY - KENTUCKY

C.H. HANNUM, U.S. Dept. of the Interior, Geological Survey, Louisville, Kentucky 40202

A statewide flood magnitude and frequency report was prepared and published in 1962, but the cut-off date for computations was the 1957 water year. The nation-wide flood frequency studies had a 1959 water year cut-off for part 3b and a 1960 water year cut-off for part 3a. The Kentucky Department of Highways has requested that the studies be updated as soon as possible. The Highway Department and their consulting engineers are the largest users of this information.

To develop procedures and techniques for estimating probable frequency of flooding on streams, gaged or ungaged, throughout the state. Update the previous report to include records at gaging stations through the 1969 water year. Data analyses to be made using the regression method rather than the Index flood method.

A comparison of the Log-Pearson Type III plots with the flood-index method plots indicates the former is appropriate when outliers are removed from the sample of peak discharges.

Multiple-regression analysis will be made of floods for designated recurrence intervals with basin parameters. Results will be regionalized and report prepared during next fiscal year.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0094, FLOOD FREQUENCY OF SMALL STREAMS IN LOUISIANA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Baton Rouge, Louisiana 70803

Definition of the magnitude and frequency of floods in streams with drainage areas of less than 10 square miles are required for hydraulic design of highway culverts.

Determine the effect of basin parameters in different physiographic settings so that methods may be established to calculate frequency of peak discharges from ungaged drainage areas of less than 10 square miles.

Stage-rainfall recording stations and crest-stage gages on selected culverts will be established on about 75 drainage areas. Drainage area parameters will be determined and final analysis made after about 10 years of data collection so that long-term runoff can be simulated.

Data collection was continued at the gages now in operation. Work was continued on culvert ratings. Emphasis was placed on processing records collected at the 50 dual-digital gages.

Data collection and data processing will be continued; computation of culvert ratings will be completed. Work will be continued for the purpose of making a preliminary analysis and providing preliminary methods of computing flood-frequency relations for small streams.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0095, HYDROLOGIC STUDIES (STORM STUDIES)

B.J. GARRETT, U.S. Army, Engineering Division, New Orleans, Louisiana 70160

There are 8 Part I and 12 Part II studies to be completed. Results of Storm Studies are summarized and published by office of the Chief of Engineers as 'Storm Rainfall of the United States,' and distributed in U. S. Army Engineer Divisions and Districts for pertinency to basic design criteria for flood control and other projects.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0096, GRAND ISLE, LOUISIANA, AND VICINITY HURRICANE PROTECTION ASSOCIATED WATER FEATURE, BAYOU LAFOURCHE - LOUISIANA (ABBREV)

UNKNOWN, U.S. Army, Engineer District, New Orleans, Louisiana 70160

Abstract: The report describes the administrative proposal for construction of about 43 miles of exterior levees together with associated borrow pits, drainage structures, and other appurtenances to provide protection from hurricane floods along both banks of Bayou Lafourche from Larose to a point 2 miles south of Golden Meadow, Louisiana. This project is located entirely in Lafourche Parish, Louisiana. Environmental impacts are discussed.

Pub. Sep. 72: 39p., NTIS No. EIS-LA-72-5427-D: PC \$4.00.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0098.

proximately 36 miles) on the west bank of the Mississippi River, including a new floodgate at Empire and construction of a new levee from Phoenix to Bohemia (approximately 16 miles) on the east bank. In addition, a barrier levee from Bohemia to 10 miles above the Head of Passes to protect the west bank of Plaquemines Parish from hurricane flooding will be built. Drainage capability and roadway access will be maintained within the project area. Environmental impacts are discussed.

Pub. Aug. 72: 34p., NTIS No. EIS-LA-72-5425-D; PC \$3.75.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0098, LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY - HURRICANE PROTECTION PROJECT

UNKNOWN, U.S. Army, Engineer District, New Orleans, Louisiana 70160

Abstract: The project is concerned with construction of barriers, levees, and hurricane protective works in Jefferson and Saint Charles Parishes, Louisiana for the purpose of flood control and protection of lives and property. Effects expected due to construction include destruction of marshes and loss of wildlife habitat.

Pub. Apr. 72: 96p., NTIS No. EIS-LA-72-5174-D; PC \$7.00.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0099, MORGAN CITY, LOUISIANA, AND VICINITY (FRANKLIN AND VICINITY AREA)

UNKNOWN, U.S. Army, Engineer District, New Orleans, Louisiana 70160

Abstract: The statement proposes a project which provides for the enlargement of 21.4 miles of existing levee and construction of 3.5 miles of new levee in the vicinity of Franklin, Louisiana, to minimize flooding from a severe hurricane. Numerous pipeline crossings will be relocated, existing pumping stations will be modified, and drainage structures will be modified or replaced to meet increased levee grades. The project will effect a complete closure of the area to be protected. The project is located in St. Mary Parish, Louisiana. Significant environmental impacts in the project area are not anticipated. Other than additional borrow areas, the project will alter the existing terrain only to the extent of raising and strengthening the existing Federal levees, and the construction of 3.5 miles of new levee. The human environment will be enhanced by protection of life and property during hurricane flooding.

Pub. Jan. 73: 66p., NTIS No. EIS-LA-73-0989-F; PC \$5.50 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0100, RED RIVER EMERGENCY BANK PROTECTION, LOUISIANA, ARKANSAS, AND TEXAS

UNKNOWN, U.S. Army, Engineer District, New Orleans, Louisiana 70160

Abstract: The project is concerned with emergency measures at 16 locations along Red River between the Mississippi River and the vicinity of Index, Arkansas for the purpose of flood control and river bank protection. Effects expected due to construction are expected to be beneficial. Unavoidable permanent adverse effects would be reduction in land area and shortening of Red River.

Pub. Jun. 72: 144p., NTIS No. EIS-LA-72-5174-D; PC \$7.00.

R.W. RAFUSE, Mathematic Incorporated, Bethesda, MD 20814

Abstract: The research, based on accepted theory and grounded in welfare economics, presents important findings in a number of controversial areas. It is concluded that the net fiscal benefits of flood control projects, but somewhat less important advantages in the determination of government willingness to contribute to flood control projects, but somewhat less important analysis of economic efficiency benefits and cost-benefit perspective. Second, its value in assessing effectiveness of investment from the federal government's perspective is negligible, since a portion of income gains are returned as tax revenues for all private expenditures. Federal expenditures.

Pub. Sep. 71: 131p., NTIS No. AD-734 834; PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0102, FLOODS FROM SMALL DRAINAGE AREAS, MARYLAND

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, College Park, Maryland 20740

Large expenditures of funds for new highway construction for improvement of existing highways have focused the attention of highway engineers on the need for more hydrologic data on small drainage areas. This project is designed to supplement existing network of stream gaging stations with the collection and analysis of runoff and rainfall data from drainage areas less than 100 acres.

Rainfall and runoff data from small drainage basins (less than 100 square miles) will be collected and analyzed using a method to predict flood magnitudes and recurrence intervals. The development of accurate flood design procedures in the past has been hampered by a scarcity of flood data from small drainage areas. The results of this study are particularly useful in establishing improved criteria for flood control structures.

About 40 crest-stage gages with flood hydrograph recorders are being operated and flood discharges are being made at miscellaneous sites. The results of this study are particularly useful in establishing improved criteria for flood control structures.

Maintenance and servicing of all gages was completed. Digital rainfall recorders and 3 digital stage recorders were installed at various gage sites. Indirect measurement of peaks from tropical storm Agnes were completed at gage sites. Long term rainfall data from two direct service rain gages were analyzed and processed to permit rainfall data at five-minute intervals. The results of this study are particularly useful in establishing improved criteria for flood control structures.

Regular servicing and data processing operations were completed. Another basin study was initiated.

Abstract: The river and flood forecast and warning service of the National Weather Service depends on meteorological data and a vast hydrologic reporting network of nearly 5000 river and rainfall stations. Reports are collected daily or on a criteria basis during periods of heavy rainfall and/or high flow in the rivers. In 1967-1969, an experiment in river and rainfall data collection via NASA's ATS-1 satellite was conducted. The technical and operational feasibility of data collection from remote sites via satellite was proved in the test. NASA will launch for NOAA in 1973 the first in a planned series of geostationary operational environmental satellites (GOES). In conjunction with this, a prototype network is scheduled for installation in the Columbia Basin of the Pacific northwest. This system could form the basis for a national data collection system to serve the nation's water resources users. During the next decade, it is anticipated that the hydrologic data collection network will double in order to satisfy river and flood forecast service needs placed upon the National Weather Service.

Pub. Sep. 71: 6p., NTIS No. COM-72-10564; Reprint.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0104, HYDROLOGIC EQUIPMENT - FLASH FLOOD ALARM SYSTEM

IF. STAATS, U.S. Dept. of Commerce, Equipment Development Lab., Silver Spring, Maryland 20910

Technical objective: Improve equipment used for measuring hydrologic parameters as requested by the NWS Office of Hydrology.

Approach: Redesign the Flash Flood Alarm System to provide for battery and radio operation. Develop, test, and evaluate electronic telemetering devices for interfacing the tipping bucket, Universal, and Fisher & Porter precipitation gages to the data acquisition remote control (DARC) telemetry system. Collect data on various evaporation measuring devices to assist energy transfer studies being performed by the NWS Office of Hydrology.

Progress: Development work on a modified Flash Flood Alarm System which will permit low power battery operation of the remote components has been completed, and T&E of this radio version of the alarm is underway. Test and evaluation is virtually completed on prototype digitizers for tipping bucket and universal precipitation gages. Energy budget measurements have been made at the Sterling Research and Development Center test site throughout the year. An experiment in heating the water in an X-3 evaporation pan to allow energy budget readings to be made through the winter has been generally successful.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0105, FLOOD PROOFING DECISIONS UNDER UNCERTAINTY - AN APPLICATION TO THE CONNECTICUT RIVER BASIN

P. AKILU, Univ. of Massachusetts, Water Resources Research Ctr., Amherst, Massachusetts 01002

Abstract: Results are presented of the economic potential of flood proofing measures for reducing flood damages. The empirical application focuses on several communities in the Connecticut River Basin. A literature review of flood proofing measures and a treatment of decision-making under uncertainty are included. A partial equilibrium framework (model) for making flood proofing choices for various types

landuses, and some remarks are made concerning the incidence of benefits and costs of such flood damage reduction measures.

Pub. Aug. 73: 109p., NTIS No. PB-228 133/5; PC \$8.50 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0106, FLOOD FLOW CHARACTERISTICS OF SMALL BASINS IN MASSACHUSETTS

C.G. JOHNSON, U.S. Dept. of the Interior, Geological Survey, Boston, Massachusetts 02203

To obtain an adequate measure of streamflow characteristics of small drainage areas, and to analyze the streamflow records for particular needs of the highway engineer.

The development of a technique for estimating the magnitude and frequency of floods on small drainage areas in Massachusetts for the use of the highway engineer.

Installation and maintenance of 10 continuous-recording stream gages with recording rain gages plus about 40 crest-stage gages on drainage basins of less than 10 square miles, all located in carefully selected places so as to sample a wide range of physiographic variables, and probably using a multiple-regression analysis.

Discharge data has been collected at 5 continuous-recording streamflow stations plus recording rainfall records in addition to annual peaks at the 15 crest-stage gages. A status report has been started.

Continuation of data collection.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0107, DESIGN OF OPTIMAL PRECIPITATION NETWORKS

W.M. GRAYMAN, Mass. Inst. of Technology, School of Engineering, Cambridge, Massachusetts 02139

Abstract: The design of a precipitation measuring network based on the cost of the network and the benefits derived from the measurements is demonstrated. A single objective, maximize net national income and a single purpose use of the measurements in a flood warning system form the basis for the analysis. Two models are developed to determine the net benefits resulting from a particular network design. One model is a simulation model in which a trace of floods is generated, the error in flood prediction as a result of precipitation measurements is simulated and the net benefits are calculated. A second model is based on the convolution of probability distributions to determine the expected value of net benefits. A case study is performed in which the expected value model is used to determine the optimal precipitation measuring system for a river basin based on data representing the West Branch of the Susquehanna River. This study indicates the importance of considering network accuracy in the design of the network and in determination of the feasibility of a flood warning system.

Pub. Mar. 73: 126p., NTIS No. PB-227 221/9; PC \$5.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0108, HURRICANE PROTECTION PROJECT, STRATFORD, CONNECTICUT

UNKNOWN, U.S. Army, New England Division, Waltham, Massachusetts

temporary or short-term effects to the hydrologic makeup of the area may occur when the control gates are closed during periods of tidal flooding

Pub. Dec. 71. 36p., NTIS No. PB-204 571-D PC \$3.00.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0109. OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, MASSACHUSETTS
UNKNOWN, U.S. Army, New England Division, Waltham, Massachusetts

Abstract: The project proposes operation and maintenance of the main harbor barrier and dike and its related structures. Environmental impacts include protection to the highly developed commercial, industrial and residential areas from tidal flooding during major coastal storms and hurricanes, serves a protective facility for harbor-based and transient vessels; compressed air jetting which causes some temporary turbidity, rodent control. Rodent control and air jetting could be considered to have possible adverse effects.

Pub. Aug. 73. 37p., NTIS No. EIS-MA-73-1353-F; PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0110. OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, NEW BEDFORD, MASSACHUSETTS

UNKNOWN, U.S. Army, New England Division, Waltham, Massachusetts

Abstract: The New Bedford Barrier is located on the northwesterly side of Buzzards Bay, 50 miles southerly of Boston, Massachusetts. It extends for a total distance of approximately 3 1/2 miles across the southerly portion of the City of New Bedford and the Town of Fairhaven. The statement concerns the operation and maintenance of the main Harbor Barrier and Dike and its related structures.

Pub. Jun. 72. 31p., NTIS No. EIS-MA-72-4782-D; PC \$3.75.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0111. NEW LONDON HURRICANE PROTECTION PROJECT, NEW LONDON, CONNECTICUT

UNKNOWN, U.S. Army, New England Division, Waltham, Massachusetts

Abstract: Construction is proposed of a 5,900 ft. system of earth filled rock protected barriers, with navigation openings, for protection of the City of New London, Connecticut, from hurricane flooding. The impact would be favorable, replacing a blighted area facing a valuable waterfront with an area where manufacturing, open space, parks, walkways, and shorefishing facilities could be developed. Views would be restricted, and a temporary adverse effect on marine life during construction would result.

Pub. Jul. 71. 21p., NTIS No. PB-201 310-F; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0112. RAINFALL-RUNOFF RELATIONS ON URBAN AND RURAL AREAS

E.F. BRATER, Univ. of Michigan, School of Engineering, Ann Arbor, Michigan 48106 (72P00617)

Objectives of the project are to gain a better understanding of the factors which control the relationships between storm rainfall, or snowmelt, and the resulting storm runoff, and to

and word processing facilities for control of pollution of water and or combined sewage

SUPPORTED BY U.S. Environ. Protect. Agency -

6.0113. FORECASTING RAINFALL AND SNOWMELT AND FLOODS ON UPPER MIDWESTERN WATERSHEDS

C.E. BOWERS, Univ. of Minnesota, St. Anthony Lab., Minneapolis, Minnesota 55414

The objective of this study is the development of procedures and the correlation of hydrologic data for the prediction and control of spring floods in the Midwest watersheds. The study is divided into three phases. The first phase, presently under way, involves the collection of meteorologic and hydrologic data concerning floods and new data pertaining to floods during the spring period. Under Phases II and III the data will be used in using available mathematical models, modification of existing models, and new models to assist in synthesizing flood runoff records, particularly for the spring season.

The Upper Midwest is a relatively flat area compared to the mountainous regions of the country; a study of the effects of snowmelt to spring floods and the critical conditions of hydrologic conditions that are characteristic of floods in this area is urgently needed. Of special interest is the water content of snow over large watersheds. The study will include with data concerning late winter and early spring precipitation, air temperature, soil temperature, soil moisture, wind, antecedent conditions, and watershed characteristics.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Div.

6.0114. BRIDGE SITE INVESTIGATIONS

C.H. TATE, U.S. Dept. of the Interior, Geological Survey, Jackson, Mississippi 39205

The Mississippi State Highway Department annually spends about \$5 million in bridge construction. Streamflow hydrologic analyses of the basin, and hydraulic analyses of the proposed crossings are necessary in proper planning of these bridges.

To prepare 20 to 50 administrative bridge-site reports as requested by the Mississippi State Highway Department.

At a typical crossing, the report is based on: (1) historical elevations recovered by the U.S. Geological Survey; (2) discharges for these historical floods determined from gauged sites; (3) flood frequency characteristics of the basin; (4) hydraulic characteristics of the crossing.

Reports including both hydrologic and hydraulic information were prepared for approximately 45 sites.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0115. SPECIAL FLOOD REPORTS - MISSISSIPPI

C.H. TATE, U.S. Dept. of the Interior, Geological Survey, Jackson, Mississippi 39205

Floods are the greatest surface-water problem in Mississippi. A record of the magnitude of these floods and a study of the history of previous floods are of value in designing flood control structures such as bridges, levees, dams and flood control works, and in planning the efficient utilization of water resources of the region.

To prepare an annual report compiling one or more of the exceptional magnitude which occur each year seasonally.

usually relatively small areas.

To describe these flood events, it often is necessary to supplement recorded information by interviewing local residents regarding flood elevations and rainfall. It is also necessary to supplement gaging station data with computed flood discharges based on highwater marks left during the flood.

Two indirect measurements were obtained from small drainage areas for the flood of July 30, 1971, on Gallagher Creek in Meridian. The report 'Gallagher Creek Flood of July 30, 1971,' was approved for open-file release in October 1971. The report 'Floods in Mississippi, October 1967 Through September 1969' was rewritten and near publication at the end of the 1972 fiscal year. Data was collected and compiled for the flood of December 6-7, 1971, in southwestern Mississippi. The report 'Floods in Mississippi, October 1969 Through September 1971' was written and in review status at the end of the 1972 fiscal year.

To collect special flood data as needed to supplement gaged data and to compile and report flood events through the 1972 water year.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0116, DESIGN FOR FLOOD CONTROL AND WAVE PROTECTION, CHAGRIN RIVER, EASTLAKE, OHIO - HYDRAULIC MODEL INVESTIGATION

C.E. CHATHAM, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: A 1:75-scale model of the lower 2000 ft of the Chagrin River and sufficient offshore area in Lake Erie to permit generation of the required test waves was used to investigate the arrangement and design of certain proposed improvements with respect to wave action and flood control. The proposed improvement plans consisted of (a) arrowhead breakwaters in Lake Erie at the mouth of the river, aggregating about 2360 ft in length; (b) realignment and enlargement of the river channel from Lake Erie through the city of Eastlake, with levees where required to supplement channel enlargement; (c) a spur channel and an access channel for navigation; (d) recreational facilities at the river mouth; and (e) the addition of beach fill and protective groins along the shoreline east of the east breakwater. A 60-ft-long wave machine and electrical wave-height measuring and recording apparatus were utilized in model operation.

Pub. Sep. 70: 92p., NTIS No. AD-756 118: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0117, DISCHARGE CHARACTERISTICS OF HURRICANE BARRIER, EAST PASSAGE OF NARRAGANSETT BAY, RHODE ISLAND - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The discharge characteristics of the navigation opening (base width of 1500 ft) in the proposed hurricane barrier for the East Passage of Narragansett Bay, Rhode Island, were investigated by means of both section and three-dimensional models. Two section models, reproducing the barrier at scales of 1:50 and 1:150, were used to determine the effect of approach depth, roughness of the barrier, and weir design on the discharge characteristics of the structure. A 1:150-scale, undistorted, three-dimensional model was used to determine the discharge characteristics of two weir plans for

presented graphically. An analysis of data was made, and discharge equations applicable to both steady state flood and ebb flows were developed.

Pub. Apr. 65: 38p., NTIS No. AD-733 847: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0118, ANSONIA-DERBY LOCAL PROTECTION PROJECT, NAUGATUCK AND HOUSATONIC RIVERS, CONNECTICUT - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The Ansonia-Derby project will provide protection for the cities of Ansonia and Derby, Conn., from flooding of the Naugatuck and Housatonic Rivers. The proposed plan for containing the river flows requires about 13,300 ft of earth dikes and 6850 ft of floodwalls, extending about 2 1/2 miles along the Naugatuck River and 2000 ft along the Housatonic River. A 1:120-scale model was used in the investigation and reproduced approximately 4000 ft of the Housatonic River and 16,000 ft of the Naugatuck River. Tests were concerned with flow conditions at bridges and channel transitions, water-surface elevations for selection of grades for the dikes and floodwalls, and velocities for use in the design of riprap to be placed on the river side of the dikes and in portions of the channel. Flow conditions were poor and water surfaces were higher than expected in the upper reach of the project; however, a satisfactory design was developed for this area. Water-surface profiles and bottom velocities were obtained with the final design for both the design discharge and the capacity flow.

Pub. Apr. 69: 46p., NTIS No. AD-723 969: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0119, PROTECTION OF NARRAGANSETT BAY FROM HURRICANE SURGES

H.B. SIMMONS, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The design of barriers for protection of Narragansett Bay against inundation by hurricane surges required use of a comprehensive model to determine the effects of proposed structures on normal tide and hurricane surge heights, current velocities, the salinity regimen of the bay, and the rates of diffusion and flushing of pollutants discharged into the bay. Model tests indicated that barriers should not be located in the central portions of the bay because of excessive buildup of surge heights downstream from such barriers, that a lower bay barrier alone could not satisfy the requirements of the Navy and at the same time afford the desired reductions in surge heights at upstream locations, but that the combination of a gated structure at Fox Point for the protection of Providence with a system of lower bay barriers with ungated openings could satisfy the requirements of the Navy for maximum current velocities and at the same time provide hurricane surge protection throughout the bay system.

Pub. Oct. 64: 122p., NTIS No. AD-718 220: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0120, 'FLOOD-CONTROL PROJECT' HOOSIC RIVER, NORTH ADAMS MASSACHUSETTS

UNKNOWN, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

6.0121.

Adams, Massachusetts, were conducted to supplement and verify hydraulic computations for the initial design or to develop alterations effecting greater hydraulic efficiency or reduction in construction costs. A 1:30-scale model was used to check such design features as chute alignment, superelevation in bends, hydraulic performance of stilling basin, weir, and transitions, requirements for intakes and outlets, wall heights, and elevations of bridges.

Pub. Jun. 62: 156p., NTIS No. AD-757 403: PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Defense - Army

6.0121, FLOOD CONTROL IN THE LOWER MISSISSIPPI RIVER VALLEY

UNKNOWN, U.S. Army, Lower Miss. Valley Div., Vicksburg, Mississippi 39180

The report describes the major flood control works in the lower Mississippi Valley and improvements on the principal tributary basins of St. Francis, Cache, West Tennessee, Yazon, Bueuf-Texas and Red River. Maps and hydrological data are also included.

Pub. Mar. 73: 39p., No copy info. available.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0122, SPILLWAY DESIGN FLOODS FOR SMALL DAMS IN RURAL MISSOURI

T.E. HARBAUGH, Univ. of Missouri, Water Resources Research Ctr., Columbia, Missouri 65201

Abstract: At present 1970, over 1500 small dams exist within the boundaries of the State of Missouri. Estimates indicate the number is growing at the rate of one hundred to two hundred per year. The main factor in possible failure of these existing dams is an inadequate spillway resulting from poor hydraulic practice and/or lack of accurate hydrologic design information. The report presents the result of a state wide analysis of all existing hydrologic data for rural watersheds less than twenty square miles. The results are presented in nomograph form for the 25 and 50 year frequency floods. The report also contains equations for other frequencies at two accuracy levels. The results of this investigation should provide designers of spillways, culverts and bridges with the latest hydrologic flood frequency data for small rural Missouri watersheds.

Pub. Jun. 70: 28p., NTIS No. PB-195 284: HC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0123, OPTIMIZATION OF OPERATION OF A SYSTEM OF FLOOD CONTROL RESERVOIRS

A.T. HJELMFELT, Univ. of Missouri, School of Engineering, Columbia, Missouri 65201

Abstract: Probabilistic methods of hydrology and optimization techniques were used to determine an optimal sequence of releases from a system of reservoirs during a flood emergency. The operation schedule for a reservoir was determined from estimated inflow to the reservoir, current reservoir contents and downstream conditions. Linear programming was used to establish the optimal operating procedure. The dura-

Pub. Jul. 73: 133p., NTIS No. PB-228 606/01: \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.

6.0124, FLOOD WAVES FROM A BREACHED DAM

T.E. HARBAUGH, Univ. of Missouri, Water Resources Research Ctr., Rolla, Missouri 65401

Abstract: A conceptual method to alleviate flood to overtopping failures of small earthfill dam operation of a relatively thin erosion retaining dam. This paper investigates the reduction in release due to the hypothetical erosion retaining dam. This paper also provides a method for the determination of the location of the layer so as to minimize possible reservoir release due to a gradually eroding dam. The transient reservoir flow is simulated in a model, based upon the solution of the one-dimensional unsteady open-channel flow equations. The boundary conditions are solved by the method of characteristics. The numerical simulation model is used to determine the reduction in reservoir release due to the eroding layer and its optimal location for a wide range of geometric, hydraulic and dynamic parameters. The sensitivity of the results to variations in the above parameters is discussed.

Pub. Aug. 71: 71p., NTIS No. PB-204 493: \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.

6.0125, APPLICATION OF HYDROLOGIC AND HYDRAULIC RESEARCH TO CULVERT SIZING IN MONTANA - VOLUME I - REPORT

E.R. DODGE, Montana State University, School of Engineering, Bozeman, Montana 59715

Abstract: A regional frequency analysis was performed using both natural and synthetic streamflow to estimate flood magnitude of various recurrence intervals for each of 230 Montana Watersheds. Using regional flood peak prediction equations for the 2, 5, 10, 25, 50, 100, and 500 year recurrence intervals were developed for various geographic regions in Montana. These estimates of the flood peak as the product of power hydrologic watershed parameters. A detailed description of the hydraulic conditions which occur for minor and major flood flow is presented along with modern methods for culvert selection.

Pub. Sep. 72: 136p., NTIS No. PB-220 093/0: \$0.95.

SUPPORTED BY Montana State University - I

6.0126, DEVELOPMENT OF AN OPERATIONAL SCHEDULE FOR MONTANA'S WATER RESOURCES - CREEK RESERVOIR OPERATION

T.T. WILLIAMS, Montana State University, Water Resources Research Ctr., Bozeman, Montana 59715

Abstract: Operational problems at Hyalite Reservoir were investigated in a one-year pilot study. The study was designed to determine which is the most effective method of irrigation operation which is

delayed so as to insure storage availability at the time of runoff peak. Linear programming and dynamic programming procedures were presented to demonstrate the feasibility of optimizing reservoir releases over a four-season period. As applied to Hyalite Reservoir, the techniques are of limited use, because spring inflows are almost always adequate to completely fill the reservoir. The techniques will be valuable when applied to a larger basin such as the Musselshell, which is under further investigation.

Pub. Sep. 73: 57p., NTIS No. PB-226 119/6; PC \$3.50 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0127, PRELIMINARY STORM DRAINAGE AND FLOOD CONTROL PLAN - UNION COUNTY, N.J.

ET. KILLAM, Union County Planning Board, *Elizabeth, New Jersey*

This report represents the second stage of the Preliminary Storm Drainage and Flood Control Plan. Specially, it provides an analysis of tidal influence upon storm drainage within the county, as well as comprehensive stream improvement programs for each of the county's watersheds. Included also with the recommended improvement plans are cost estimates for the proposed improvements and recommended program staging and implementation procedures.

Pub. May 71: NTIS on Union County Planning Board Courthouse, *Elizabeth, N.J.*, H.U.D. Regional Office Library, *Region, New York, New York*.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0128, FACTORS PERTINENT TO WATER QUALITY IN THE ALBUQUERQUE METROPOLITAN AREA

UNKNOWN, Albuquerque Urban Observatory, *Albuquerque, New Mexico*

Abstract: The focus of the report is on the problems associated with the Albuquerque metropolitan area's water supply and waste water, and additional problems, such as flood control, as they relate to these two primary areas of focus. The report contains a detailed tabulation of pertinent legislative authority; a description of some actual administrative procedures; a review of geological and geographic factors; a summarization of current master plans; a description of equipment, personnel, and personnel training; and a listing of funding and advisory sources.

Pub. Nov. 70: 87p., NTIS No. PB-208 122; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0129, INVESTIGATION AND ANALYSIS OF FLOODS FOR SMALL DRAINAGE AREAS IN NEW MEXICO

A.G. SCOTT, U.S. Dept. of the Interior, Geological Survey, *Santa Fe, New Mexico*

The State Highway Department needs flood-frequency, and magnitude of floods, to better design highway drainage structure.

To obtain and analyze hydrologic data which can be used in the design of highway drainage structures. More specifically, to obtain and analyze hydrologic data from a series of flood

150 crest-stage gages. Small basins in diverse areas will be selected to insure a wide sampling of the various basin parameters. The relations between rainfall and runoff will be defined. This relation will produce a record of synthetic floods. The measured and synthetic floods will define a frequency curve representative of the site. The frequency characteristics will then be related to basin characteristics by regression analysis. The resulting relation should produce reliable estimates of flood-frequency characteristics in small basins throughout the state.

Collection of discharge, peak flow, and precipitation data continued. All data were updated, coded, and submitted for storage on computer. A long record of annual peaks for one flood-hydrograph station was synthesized by utilizing the USGS Rainfall-Runoff Model. Work was completed on the evaluation of the data collection phase of the project and the report submitted for review.

Continue data collection and tabulation.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0130, REGIONAL COMPREHENSIVE MULTI-PURPOSE WATER RESOURCES PLANNING STUDIES IN NEW YORK

J.A. FINCK, State Dept. of Env. Conserv., *Albany, New York* 12205

The project is composed of a number of individual regional water resources planning studies, each of which includes an inventory of the area's water resources, both quantity and quality, an assessment of present water resources management needs and opportunities, as well as projections of future needs. Categories of water use included are water supply, water quality, irrigation, recreation, fish and wildlife, power, navigation and flood control. Projections of needs and opportunities are derived from an economic base study and the recommended management plan is selected from sets of alternative measures.

Basic data on hydrology, economics and water utilization are obtained from review of existing information as well as collection using field observation interviews and mail questionnaires.

Each river basin study is under the auspices of one or more regional planning boards. At present, studies are underway or completed in eleven board areas. The Erie-Niagara Basin study has been completed. The Oswego River Basin is being cooperatively studied by three regional boards, the Susquehanna by two and the Delaware, Black, St. Lawrence, Genesee and Allegheny Basins each by one board. These latter studies are scheduled for completion generally in 1974.

A regional board is composed of seven local residents of the area to be studied and is appointed by the Department of Environmental Conservation. The boards are responsible for the conduct of the study including the development of the comprehensive plan for the management of their region's water resources.

SUPPORTED BY New York State Government - Albany

6.0131, USE OF SYSTEMS ANALYSIS IN THE DEVELOPMENT OF WATER RESOURCES MANAGEMENT PLANS FOR NEW YORK STATE - ADDENDUM

C.S. LIU, State Dept. of Env. Conserv., *Albany, New York* 12205

6.0132.

linear programming technique used generated a flood control utility measuring function to the monthly operations model which indicated the available storage for conservation purposes.

Pub. Jul. 71: 70p., NTIS No. PB-205 281: PC \$3.00 MF \$0.95.
SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0132. AN EVALUATION OF URBAN FLOOD PLAINS
J.E. GODDARD, Amer. Soc. of Civil Engs., New York, New York 10017

Abstract: Using 26 'Urban Areas' with populations ranging between 50-thousand and 7-million persons as a national sample, close to one-sixth of urban lands in the U.S. lie within natural 100-year flood plains, and slightly over one-half of such flood plains already have been developed. Average annual flood damages for urban areas may be about three-fifths of the national total. Slightly over half of the national investment in flood control works have been for the protection of urban areas. Information available does not permit estimation of implied benefits. In comparison, well over one-half of urban lands are served by systems of underground drainage that represent over four times the capital investment in flood plain protection and are associated with approximately the same level of average annual flood damages. Much of the flood-plain flooding problem as well as the land-runoff water quality problem could possibly be more effectively countered on the land feeding urban watercourses, provided planning and development of drainage systems and flood plain management programs can be coordinated and integrated. Specific recommendations are made on acquisition of needed information. There are implications for emerging national water policies.

Pub. Dec. 73: 48p., NTIS No. PB-227 337/3: PC \$3.25 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0133. WATER RELATED ENVIRONMENTAL SERVICES

UNKNOWN, Central New York Reg. Pln. Bd., Syracuse, New York

Abstract: The report summarizes the analysis phase of water supply, sewage disposal, storm drainage, and flood control in the Central New York Region. Present and expected problems of service quality and quantity have been examined along with potential measures to alleviate these problems and upgrade service. Interservice and service-to-environment relationships, involving such factors as environmental quality, benefit-cost considerations, economics of scale, and intertie arrangements, were noted throughout the analysis. The analysis included an examination of the various possible solutions to each locale's needs; some of the more involved alternatives are dealt with in detail.

Pub. Nov. 70: 149p., NTIS No. PB-198 086: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0134. EFFECTS OF URBANIZATION ON FLOODS AT WINSTON-SALEM, NORTH CAROLINA

A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey, Raleigh, North Carolina 27607

encroachment, many areas which were formerly undated are now flooded with increasing frequency.

Hydrologic data before and after urban development is usually unavailable. Therefore, rainfall-runoff of watersheds that are in the same region but in different stages of urbanization will be used for analysis and comparison. (1) Evaluate quantitatively the flood potential of watersheds smaller than 5 square miles. (2) Derive relationships for determining peak discharge from small watersheds by evaluating the effects and relationships of natural and urban characteristics.

Continuous rainfall and runoff data will be recorded at selected sites. The recorded data will be in conjunction with long-term rainfall to generate long-term runoff data. The generated data and short-term data along with observed long-term data for the region will be used in several linear regression analyses to determine relationships of relationship to basin characteristics which physical factors and changes can be evaluated. Important factors will be combined in formulas for peak discharge having selected recurrence intervals.

Analysis of the data for this project has been completed. Preparation of the final report has been started. Investigators have used a family of curves, each depicting a different degree of urban development, to relate basin characteristics to the stream length divided by the square root of slope (L/\sqrt{S}). For this project the relationship between the area of impervious cover to the total drainage area is included in the analysis to define the basin lag time. As a result, only one curve is required to depict the effects of urban development. The report was substantially completed at the end of the year.

Complete and publish report of project results. The collection of recurring records will continue under project N001FOCL surface water stations.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0135. EFFECTS OF URBANIZATION ON FLOODS AT DURHAM, NORTH CAROLINA

A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey, Raleigh, North Carolina 27607

The City of Durham (as most cities) is faced with problems of drainage and damage resulting from flooding of streams. Drainage problems include design of small culverts, storm sewers, and stream-channel encroachment. Because of urban developments in the basin and encroachment, many areas which were formerly undated are now flooded with increasing frequency.

Hydrologic data before and after urban development is usually unavailable. Therefore, rainfall-runoff of watersheds that are in the same region but in different stages of urbanization will be used for analysis and comparison. (1) Evaluate quantitatively the flood potential of watersheds smaller than 5 square miles. (2) Derive relationships for determining peak discharge from small urban watersheds by evaluating the effects and relationships of various natural and urban characteristics.

Continuous rainfall and runoff data will be recorded at selected sites. The recorded data will be in conjunction with long-term rainfall data. The generated short-term data along with observed long-term data for the region will be used in several linear regression analyses to determine relationships of relationship to basin characteristics which physical factors and changes can be evaluated. Important factors will be combined in formulas for peak discharge having selected recurrence intervals.

Data collection and analyses were completed during the previous year. A report on this and other urbanization projects, as described under reports for project No. NC 62-030C, Charlotte, will be forthcoming.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0136, EFFECTS OF URBANIZATION ON FLOODS AT LENOIR, NORTH CAROLINA

A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey, Raleigh, North Carolina 27607

The City of Lenoir (as most cities) is faced with problems of drainage and damage resulting from flooding of small streams. Drainage problems include design of small bridges, culverts, storm sewers, and stream-channel treatment. Because of urban developments in the basin and flood-plain encroachment, many areas which were formerly rarely inundated are now flooded with increasing frequency.

Hydrologic data before and after urban development are usually unavailable. Therefore, rainfall-runoff data from watersheds that are in the same region but in different stages of urbanization will be used for analysis and comparison to: (1) Evaluate quantitatively the flood potential of urban watersheds smaller than 5 square miles. (2) Derive usable relationships for determining peak discharge from small urban watersheds by evaluating the effects and relation of various natural and urban characteristics.

Continuous rainfall and runoff data will be recorded concurrently at selected sites. The recorded data will be used in conjunction with long-term rainfall data to generate expected long-term runoff data. The generated and observed short-term data along with observed long-term data in the region will be used in several linear regression models for determination of relationships to basin characteristics for which physical factors and changes can be evaluated. Significant factors will be combined in formulas for peak discharge having selected recurrence intervals.

Data collection and analyses were completed during the previous year. A report on this and other urbanization projects, as described under reports for project No. NC 62-030C, Charlotte, will be forthcoming.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0137, USE OF MULTISPECTRAL PHOTOGRAPHY IN WATER RESOURCE PLANNING AND MANAGEMENT IN NORTH CAROLINA

C.W. WELBY, Univ. of North Carolina, School of Agriculture, Raleigh, North Carolina 27607

The basic objective of this investigation is determination of the extent to which multispectral photography is useful in North Carolina water resource planning and management. A four lens multispectral camera will be flown over various test sites to evaluate its use in water pollution monitoring, in studying of flooding along streams, and in evaluation of sediment distribution in lakes and estuaries. Attention is to be given to the cost-effectiveness of the method.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

6.0138, MAGNITUDE AND FREQUENCY OF FLOOD DISCHARGES FROM SMALL DRAINAGE BASINS, EFFECTS OF DRAINAGE BASIN CHARACTERISTICS - NORTH DAKOTA

DAVID C. GIBSON, U.S. Dept. of Interior, Geological Survey,

could result in improved methods of computing probable flood flows from small areas.

To provide a method of evaluating the effect of basin characteristics on the magnitude of flood flows.

Three separate areas across the state with adjoining basins of different shape are heavily instrumented for rainfall and runoff data. This data will be collected for various rainstorms and evaluated for effects on flood magnitude.

During the first quarter of the 1973 water year records of all rainstorms and streamflow were obtained. Field data collection terminated as of October 1972. Collection of basin parameters was completed. Analysis of the data is in process.

A completed report is planned for early in the 1974 fiscal year. The data are being analyzed through regression equations.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0139, STATEWIDE FLOOD-FREQUENCY REPORT - OKLAHOMA

V.B. SAUER, U.S. Dept. of the Interior, Geological Survey, Oklahoma City, Oklahoma 73102

The safe and economic design of highway bridges, culverts, and embankments which cross the water-drainage systems of the state requires the use of all available data, as well as current and technically sound analytical methods. The advent of improved analytical techniques, along with associated computerized capabilities, and the availability of 13 subsequent years of factual flood experience (1959-71) now make it appropriate to undertake a more detailed study of the parameters pertinent to prediction of flood magnitudes at any site in the state.

The purpose of the study will be to perform a statistical analysis of the magnitude and frequency of annual flood peaks experienced during natural flow conditions at gaging sites in Oklahoma, to relate the most important of the physical parameters of the drainage basins to peak discharges of selected recurrence intervals by appropriate diagrams, so that the reliability and versatility of methods used to estimate magnitude and frequency of peak discharges for ungaged natural drainage basins in the state of Oklahoma will be improved, and to provide a measure of the accuracy of estimates of flood magnitude and frequency.

The computer-data bank on annual flood peak discharges will be utilized to obtain the flood frequency relation at each gaged site on the basis of the Log-Pearson Type III statistical distribution. The indicated 2-, 10-, 25-, and 50-year flood discharges for each site will be related to various basin and hydrologic parameters using multiple-regression techniques. Results of the analyses will be studied in relation to geographic bias and regions having similar flood-frequency characteristics will be delineated. A report will be prepared giving techniques and diagrams useful for estimating flood frequency throughout the state.

Report has been completed and is ready for outside technical review.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0140, INVESTIGATION AND ANALYSIS OF FLOODS FROM SMALL WATERSHEDS IN OKLAHOMA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Oklahoma City, Oklahoma 73102

specifically needed by the Highway Department to provide a basis for design of highways and the accompanying hydraulic structures.

To investigate the magnitude and frequency of occurrence of flood peaks from watersheds ranging in size from one to twenty square miles by recording and analyzing flood peaks at approximately 100 locations throughout the state. To prepare a report of the investigations that will provide a basis for development in small watersheds and for design of hydraulic structures.

Install and operate about 100 crest-stage gages on small watersheds throughout the state. The sites will cover areas ranging from 1 to 20 square miles and will be selected on the basis of physiographic and climatic features. Approximately 50 percent of the sites will be equipped with type SR recording gages with precipitation attachments. The relationship of flood peaks to size of watershed and basin characteristics will be studied, utilizing multivariate statistical methods. Water records will be published in annual reports and an open file report will be prepared to cover the analytical and interpretative data.

The effort expended on this project during the year has been the continuing periodic inspection and maintenance of 60 SR recorders and 45 crest-stage gages. Current meter and indirect measurements were made of many flood flows. The 2 year and 10 year frequency floods were computed for 77 stations and the areal frequency curves of the 1964 statewide flood frequency report were extended downward to drainage areas consistent with the small streams in that area.

The major activities during the year will be (1) routine inspection and maintenance of gaging sites; (2) review discharge ratings and improve where necessary; (3) reduce the precipitation and runoff data to proper form for the Dawdy model and run the optimization program for about 35 sites; (4) simulate annual peaks for about 35 sites using long term precipitation record and do a frequency analysis on the extended data.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0141, BIG HILL LAKE, BIG HILL CREEK, KANSAS

UNKNOWN, U.S. Army, Engineer District, Tulsa, Oklahoma

Abstract: The project is located in Labette County, Kansas, on Big Hill Creek. Action consists of the construction of a lake for flood control, water supply, and recreation. Damages resulting from flooding in the creek below the dam will largely be eliminated and associated epidemic threats will be reduced. The high quality water supply will provide the need projected over the next 100 years. The lake will require that 2,700 acres of land be changed from private to public ownership. Two miles of roads will be inundated. Telephone and powerlines in the lake area will also require abandoning or relocating. Upland game habitat in the lake area will be adversely affected. There will be some temporary construction scars and there will be noise and air pollution during construction.

Pub. Jul. 72: 198p., NTIS No. EIS-KS-72-4859-D: PC \$12.00.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0142, BIRCH LAKE, BIRCH CREEK, OKLAHOMA

UNKNOWN, U.S. Army, Engineer District, Tulsa, Oklahoma

fishery, while 1,137 acres of wildlife habitat pool area will be lost.

Pub. Sep. 72: 183p., NTIS No. EIS-OK-72-53: MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0143, TEST OF THE ERTS-DATA SYSTEM IN THE SUSQUEHANNA RIVER

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Harrisburg, Pennsylvania 17104

The potential use of earth orbiting satellite data for flood warning has not been well explored.

The objective of this project is to test the technology satellite data collection system gages in the Susquehanna River Basin for flood

Four data collection platforms will be field in gages in the basin. Data relayed from the gages will be provided to the Susquehanna River Basin Commission. National Weather Service's River Forecasting Office, Harrisburg.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0144, OPTIMAL ANTECEDENT PRECIPITATION INDICES FOR SMALL EASTERN WATERSHEDS

B.M. REICH, Penn. State University, Institute for Resources, University Park, Pennsylvania 16802

The research involves an investigation to determine antecedent precipitation indices which are related to flood response. Joint probabilities for series of storm rainfall and antecedent conditions are calculated for different seasons, physiographic characteristics, watershed anomalies. The results of the research are applicable to small watersheds in Pennsylvania and the United States.

Research procedures will include digital computation of rainfall, flood hydrographs, and watershed characteristics. Multiple and multivariate regression techniques will be used.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0145, FLOOD PREDICTION METHODS FOR PENNSYLVANIA HIGHWAY CROSSINGS

B.M. REICH, Penn. State University, School of Civil Engineering, University Park, Pennsylvania 16802

Abstract: The objective of this study was to develop simple methods for hydrologic design of culverts for Pennsylvania watersheds in the size range of one-half to 200 sq. miles. All the annual peak discharges for Pennsylvania watersheds in this range were collected and supplemented with data from stream gauges. Also flood hydrograph and corresponding rainfall were collected. This information was supplemented with maps and aerial photos and soils and geological data for watersheds. From these aerial photos and maps numerous parameters describing physical characteristics of watersheds were obtained.

Pub. Sep. 71: 203p., NTIS No. PB-210 317: MF \$0.95.

SUPPORTED BY U.S. Dept. of Transportation

for each water year. Floods are arranged in order of magnitude for each watershed and plotted as points on extreme value paper. Exact locations to which the data apply are described. For each plot the following information is given: major river basin in which each stream is located, stream name, area in square miles of each topographic drainage basin, number of years of data available, mean of the annual series of floods in cubic feet per second, standard deviation of the annual series in cfs, and coefficient of skewness of the logs (to base 10) of the annual series values. Practitioners are asked to judge the general trend of the observed flood curves and rate them as to fit for Gumbel lines, Log-Gumbel curves, or Log-Pearson Type III curves. Judgments as to whether a horizontal asymptote will ultimately be reached and also for except outliers are also requested. Questionnaires are included in the publication. Results for these questionnaires will be analyzed anonymously and submitted for publication in a technical journal where hydrologists can express their opinions in printed discussions.

Pub. Dec. 69: 90p., NTIS No. PB-193 704; HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0147, FLOOD INVESTIGATIONS - TENNESSEE

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Nashville, Tennessee 37203

For many vital and worthwhile purposes, man and his works must encroach upon the flood plain. Intelligent and economically feasible encroachment demands a good understanding and quantitative description of the magnitude and frequency of floods. In the design of adequate and economical bridge and drainage structures, a knowledge of the hydraulic and flood-frequency characteristics of intersected streams is essential. Additional data are needed on smaller streams to adequately define frequency relations and to provide methods of estimating the flood characteristics at specific ungaged sites.

The goal is to measure maximum annual and supplementary flood-peak stages and discharges at a network of crest-stage gages to supplement data collected under the regular gaging station program; to appraise and generalize the flood characteristics of Tennessee streams; and to define flood characteristics at specific sites for highway-structure design.

(1) Operate a network of about 90 crest-stage partial-record stations on small streams and in parts of the State where additional flood data are desirable; (2) develop statewide flood-frequency relations by multiple-regression techniques using flood-peak data from both crest-stage and continuous gaging stations and numerous basin characteristics; (3) investigate outstanding floods on ungaged streams; (4) prepare bridge-site analyses, unpublished reports; and (5) verify hydraulic techniques at sites where bridge studies have been previously made.

Routine operation of the 86 crest-stage gages continued. Eleven special bridge-site studies were made at the request of the Tennessee Department of Highways. Flood data were also furnished informally for many other proposed bridge sites. Work was completed on basin characteristics and preliminary flood-frequency analyses were made.

Continue data collection at crest-stage gages and prepare special site reports as requested by the Tennessee Department of Highways. Emphasis will be on improving state-discharge relations at the crest-stage stations and the completion of flood-frequency analyses.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

UNKNOWN, State Div. of Comp. Planning, Austin, Texas

Abstract: The Report is number Two of 4 separate reports done in two phases. Phase I: Collection of data and information (Report 1). Phase II consists of three reports: (2) Comprehensive Plan; (3) Administrative Controls; (4) Capital Improvements Program. This Report is based on long-range goals and objectives, recommends residential, commercial, industrial and park expansion; proposes an inner loop system for easy accessibility to the total planning area; recommends improvements for Peam Creek, and construction of five flood-retarding structures which will greatly enhance the aesthetic values of the community.

Pub. May 72: 126p., NTIS No. PB-212 172; PC \$8.50 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0149, HYDROLOGIC INVESTIGATION OF SMALL DRAINAGE AREAS IN TEXAS

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

Insufficient data are available to develop a method that will predict the magnitude of floods for selected recurrence intervals on streams having less than 20 square mile drainage area. An acceptable method is urgently needed for the intelligent design of bridges and culverts.

To derive the 'frequency and magnitude' relationship of floods for streams having less than 20 square mile drainage area. This relationship must be continuous with that used for larger drainage areas. The derived relationship will be published in a readily usable form.

Establish and operate a network of gaging stations to collect annual maximum, flood-hydrograph, and rainfall data. Locate these stations to obtain a representative sample of all hydrologic, meteorologic, and physical characteristics. After sufficient data are obtained, appropriate analysis will be made. Methods presently used to derive the frequency-magnitude relation for large drainage areas may be refined or modified to include small drainage areas. Types of studies under consideration include Multiple-Regression Analysis, Log-Pearson Type Frequency Distribution, USGS (Dawdy) Model, and Index-Flood Method.

Data were collected and tabulated as scheduled. The physical characteristics--drainage area, main channel length, and slope index--have been tabulated from USGS topographic maps (scale 1:24,000) for 138 sites. When maps become available, the same characteristics will be tabulated for the remaining 12 sites. Station-frequency analysis was made for small streams in East Texas.

Continue operation of the network. Update the list of physical characteristics. Tabulate long-term rainfall records and test the Dawdy Model using available data. Also, do a preliminary flood-frequency analysis for small streams in the remainder of the State.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0150, OPTIMAL FLOOD ROUTING USING STOCHASTIC DYNAMIC PROGRAMMING

W.S. BUTCHER, Univ. of Texas, School of Engineering, Austin, Texas 78712

The proposed research will aim at the development of flood routing policy decisions using an economic objective which expresses the economic consequences of flood flows

6.0151.

Initially flood flows will be examined at a particular location such as a dam. These inflows will be analyzed for conditional probabilities between flows in successive time periods. Parameters to be examined for possible correlation will be flow in one or two preceding time periods, precipitation at a key station, etc.

Using these conditional probability matrices, an optimal policy for flood routing will be derived using stochastic dynamic programming. The policy will be in the form of decision matrices, where the state of the system is described by the state variables used in the probability matrices of flows.

The optimal policies will be capable of being used for realtime flood routing or in model studies. They can also be used to directly evaluate the value of accuracy in flood forecasts. Where the economic objective used is a monotonic function of maximum flow, that objective function will yield the same flood routing policy as using the hydrologic one of minimizing the flood peak. The proposed method however will not be limited to that function alone and will allow more rational flood management by using realistic economic functions where damage is also related to factors such as length of time of inundation. It will also be possible to use the method to evaluate the flood control reservations in a multipurpose reservoir to compare that with the economic worth of that space if put to other use.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0151. ALTERNATE SOLUTIONS TO WATER RESOURCE DEVELOPMENT-A CASE STUDY - TEXAS

D.R. BASCO, Texas A & M University System, School of Engineering, College Station, Texas 77843

All potential alternative solutions to water resource problems should be investigated in order to achieve optimum utilization of national financial resources allocated to water resource development. Often in the past, only reservoir impoundment structures have been considered as a solution and only alternative location or impoundment schemes have been analyzed.

The impact of traditional reservoir developments on the environment has received little attention. Increased pressure by ecologically concerned groups regarding the environment is resulting in a renewed interest in new, alternative solutions to water problems.

This research proposes to study the planned U.S. Government reservoir project on the Navasota River Watershed in Texas. The project will be directed at examining, on an engineering basis, the feasibility of alternative ways of meeting the flood control, water supply and recreation objectives of the Navasota River watershed plan. The basic Corps of Engineer planning documents reveal that only impoundment structure solutions were previously considered.

Because each proposed optimal solution to a water resources problem must be unique for the particular area of interest, especially when all alternatives are considered, a study of alternative solutions in general may not stimulate water resources planners to seek new solutions. Consequently, the case study approach would appear more valuable to (1) quantitatively document actual order-of-magnitude differences between alternatives and, (2) give publicity and a focus to the idea so that more creative solutions to the nation's water resources problems may be conceived in the future.

Abstract: The proposed action consists of completion of a hurricane flood protection system to Port Arthur, Texas and vicinity from damage caused by tropical cyclones of magnitudes up to project hurricane. Started in 1966, the project involves strengthening, enlarging, and extending a local flood protection system. The completed system will include a series of protective works and protect an area of approximately 100 square miles with a total population of about 100,000 and property values of about \$1.5 billion. The completed system included about 9.4 miles of levees, about 4.3 miles of dikes, 3 major pumping stations, and numerous other appurtenant structures. Environmental impacts are described.

Pub. Nov. 73, 21p., NIS No. FIS-TX-73-1785-1
SUPPORTED BY U.S. Dept. of Defense - Army

6.0153. MODELING THE TOTAL, INTEGRATED, AND SOCIOLOGIC FLOW SYSTEM OF URBAN FLOODS - PHASE III

W.H. ANDREWS, Utah State University, School of Engineering, Logan, Utah 84321 (C-5177)

This project is the third phase of a study which is directed toward the development of a general technique for solving metropolitan flood problems through a joint consideration of both the physical and social dimensions. The project employs simulation procedures as a technique for integrating both of these dimensions into the logic of the flood routing process with respect to urban flood problems.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0154. PRESENT AND POTENTIAL MULTIPLE USES OF CANAL SYSTEMS - PHASE I

K. UNHANANI, Utah State University, Utah State Water Resour. Res., Logan, Utah 84321

This proposed research consists of the investigation of the feasibility of the multiple use of canal systems. Multiple use planning is often applied to large rivers and seldom been concerned with canal systems. The project. This research will investigate the feasibility of using canal systems for such multiple uses as flood control, drain-off, fishing, and bank recreation (e.g., cycling). The studies will include the social, economic, engineering, ecological and economic aspects. The research will be conducted in two phases; Phase I will be the investigation of the multiple use concept for the development of a canal system.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0155. REVIEW EMERGENCY RELIEF FUNDING TO DETERMINE THE TREND OF BRIDGE LOSSES DURING FLOOD CONDITIONS

F. CHANG, Unknown Inst. or Indiv. Grant, Virginia

Tasks are: Conduct a literature review to identify existing forms and to establish a procedure and design forms on which to compile and tabulate data. Provide a proposed form which field engineers can use to make damage surveys so that information is available for the future.

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Arlington, Virginia 22209

Few long-term runoff records exist for small drainage basins. The need for long-term records for small basins is great. The records are used in the design of highway crossings, in urban planning, and in water-resource development. The development of computer simulation models, such as rainfall-runoff relations and multivariate generating processes, will provide means for synthesizing long-term runoff records. Some of these models will permit simulation of basin response to varying environmental conditions.

The emphasis will be to study and develop, as feasibility and needs dictate, runoff simulation models to provide synthetic data for specific applications such as flood investigations, urban storm runoff, and mean monthly flows. The emphasis has been to synthesize flood peaks for rural drainage basins. Future work will encompass more complex models to synthesize urban storm runoff, daily discharge in rural basins, and combining subbasin runoff to estimate basin outflow. In areas where rainfall-runoff relations are impracticable, models such as multivariate generating processes will be developed.

Operational versions of runoff simulation models will be programmed for a variety of environmental conditions. Criteria for selection and delineation of input data for models will be developed. Methods of climate-record transposition will be investigated. Limitations in the application of each model will be explored. Approaches to the synthesis of large basin runoff through distributed routing of synthesized small basin records will be initiated. Multivariate generating processes will also be utilized to synthesize runoff.

Synthetic flood frequency data derived by rainfall-runoff modeling of 65

Continue evaluation of information content of rainfall-runoff model output (long-term synthetic flood frequency statistics). Develop 'optimum' model calibration procedures (computer programs) in relation to the worth of synthetic data.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

HAZARD REDUCTION

6.0157, STUDY OF GUIDELINES FOR LAND MANAGEMENT AND USE OF FLOOD-PRONE AREAS IN ALABAMA

S.P. SNOW, Auburn University, Center for Urban & Reg. Plan., Auburn, Alabama 36830

Abstract: Act No. 119 of the Legislature of Alabama, Third Special Session, 1971, provides enabling legislation for a comprehensive land management and use program in flood-prone areas of the state, allows governmental units in Alabama to meet requirements of the National Flood Insurance Act of 1968, and authorizes the county governing body in each county to prescribe criteria for the land management and use of such areas.

Pub. Feb. 73: 188p., NTIS No. PB-225 214/6: PC \$11.50 MF \$1.45.

SUPPORTED BY Auburn University

6.0158, A GUIDE FOR REDUCING FLOOD DAMAGE IN

The Guide for Reducing Flood Damage in the South Alabama Region comprises an inventory and evaluation of the major flood prone areas of Baldwin, Escambia and Mobile Counties, Alabama. These areas were studied with the purpose of reducing or eliminating danger to human life, existing and future structures.

Land areas within flood plains subject to inundation have been delineated and the flood danger zones have been described. Proposed criterion for State, Regional or County flood plain management have been recommended and model land use controls and codes reflecting the recommendations are available upon request at the Commission's office.

Pub. Jun. 71: NTIS on HUD Reg. Off. Lib., Region IV, 645 Peachtree, Seventh Building, Atlanta, Ga.,

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0159, FLOOD MANAGEMENT STUDY

UNKNOWN, Tuscaloosa Area Comm. of Gov., Tuscaloosa, Alabama

Abstract: The study identifies the general extent of flooding and recommends means of flood problems. It covers all of Tuscaloosa and Pickens Counties and the Town of Moundville in Hale County. The study provides an introduction to the problem of flooding in the area and serves as a starting point for developing an areawide flood plain management program. Methods to reduce potential flood damages to structures are recommended along with restrictions for land use in flood prone areas and policies to minimize soil erosion.

Pub. May 71: 89p., NTIS No. PB-199 569: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0160, FLOOD MANAGEMENT STUDY, TUSCALOOSA, PICKENS COUNTY AND MOUNDVILLE, ALABAMA, MAY 1971

UNKNOWN, Tuscaloosa Area Comm. of Gov., Tuscaloosa, Alabama

This study identifies the general extent of flooding and recommends means of flood problems. It covers all of Tuscaloosa and Pickens Counties and the Town of Moundville in Hale County. The study provides an introduction to the problem of flooding in the area and should serve as a starting point for developing an areawide flood plain management program.

Methods to reduce potential flood damages to structures are recommended along with restrictions for land use in flood prone areas and policies to minimize soil erosion. Dams to reduce flooding and augment low stream flow are also recommended.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0161, FLOODWAY EVALUATIONS BEFORE & AFTER CHANNEL MODIFICATIONS ASSUMING TOTAL METROPOLITAN DEVELOPMENT IN DRAINAGE BASINS JEFFERSON COUNTY, ALABAMA

A.L. KNIGHT, U.S. Dept. of the Interior, Geological Survey,

Delineate floodways for 500-year recurrence interval flood assuming total metropolitan development. (3) Furnish data to assist in a designing floodway channels, b. planning and controlling development of flood plains, c. designing structures on/or crossing flood plains.

The 500-year recurrence interval flood along designated streams will be computed assuming total metropolitan development. Floodways for 500-year recurrence interval flood will be delineated for existing channel conditions and with modified channel conditions. Maps delineating flood plains and floodways will be prepared where needed. Peak discharges, flood frequency, and stage frequency will be determined for selected sites. Jefferson County will provide survey and construction work as needed.

Field surveys of valley cross sections and bridge crossings were completed on Shades Creek which consisted of 44 miles of channel. Roughness coefficients were estimated and the cross sections were coded for automatic processing in a step backwater program to determine flood plain limits. Administrative progress reports have been submitted to the Cooperator quarterly.

Complete Shades Creek Floodway Evaluation. Collect and prepare channel data on Fivemile Creek for automatic data processing in a floodway evaluation of this stream. Install and operate approximately 15 rainfall-runoff gaging stations on streams in Jefferson County.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0162, LAND-USE REGULATIONS IN FLOOD-PRONE AREAS - A SUMMARY OF THE WISCONSIN STUDY AND AN ANALYSIS OF ALABAMA LAND-USE LAW

H. COHEN, Univ. of Alabama, Natural Resources Center, University, Alabama 35486

Abstract: The study reflected by this report was commissioned for two purposes. The first relates to a Wisconsin study which explores legal issues involved in the regulation of private and public land uses in the flood plains. The second part relates the present Alabama legal environment with the Wisconsin Study and suggests methods of control.

Pub. Nov. 70: 117p., NTIS No. PB-211 071: PC \$3.00 MF \$0.95

SUPPORTED BY University of Alabama

6.0163, DEVELOPMENT OF AN ALASKAN CONCEPTUAL WATERSHED MODEL.

R.F. CARLSON, Univ. of Alaska, Inst. of Water Resources, Fairbanks, Alaska 99701

A long term program of developing conceptual hydrologic modeling tools for Alaskan conditions is being conducted with this project. Present modeling programs for snowmelt generation, potential evapotranspiration, general watershed processes, and spring breakup runoff will be extended both with respect to regional location and to specific use. The potential usefulness of conceptual models for operational flood forecasting on the Chena River watershed will be investigated and compared to more conventional methods. Also, the project will adapt conceptual modeling techniques to the Anchorage and Kodiak regions and study the causes and effects of streamflow variability.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

6.0164, APPLICATIONS OF AERIAL MEASUREMENTS TECHNIQUES

M.L. BROWN, U.S. Dept. of the Interior, Geological Survey, Prescott, Arizona 86301

lakes and estuaries, ice packs, and urbanization of watersheds. Techniques include side-looking airborne radar, multi-spectral sensing, infrared imagery, aerial photography, thermal imagery.

Sophisticated techniques and instrumentation for airborne remote sensing of hydrology have been developed through a WRD research program and demonstrated in actual use. The project is to provide data collection services on a reimbursable basis to WRD districts, other divisions within the survey and other federal agencies by applying the techniques that have been developed. Techniques include side-looking airborne radar, multi-spectral sensing, infrared imagery, aerial photography, thermal imagery. Support will be provided as required to the developmental program.

Information will be circulated to regional and district offices concerning the services available and their costs, and requests for data will be solicited. Data collection will be scheduled in accordance with requirements of requestors. The data product will primarily be in the form of film records.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0165, DEVELOPMENT OF AERIAL MEASUREMENT TECHNIQUES

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Prescott, Arizona 86301

Development of aerial measurement techniques to be applied to hydrologic problems, such as floods, industrial or natural pollution, streamflow characteristics, dynamics of lakes and estuaries, ice packs, and urbanization of watersheds.

The research effort for development of remote sensing techniques has successfully produced sophisticated methods and equipment. Research is not required at this point. Rather, a developmental program is required in the applications of techniques resulting from the research effort, in the training of others in applications of techniques, and in the utilization of the data required.

Provide training for techniques in the maintenance and use of remote sensing equipment; for scientists and technicians in the utilization of data; and advise division, regional and district leaders on the availability and usability of remote sensing data; complete a handbook (manual) on remote sensing (in progress); acquire very fine, sophisticated remote sensing equipment from military sources and adapt it to the needs of the hydrologic data collection program; develop a program of real-time remote sensing. Techniques include aerial photography, side-looking airborne radar, infrared and thermal imagery, multispectral imagery.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0166, THE IMPACT OF URBANIZATION ON WATER YIELD, FLOOD PEAK, SEDIMENT YIELD, AND WATER QUALITY IN THE BERKELEY HILLS, CALIFORNIA

J.R. MCBRIDE, Univ. of California, School of Forestry, Berkeley, California 94720

The objective of this study is to develop models which relate changes in water yield, flood peak, sediment yield, and water quality to urbanization of a watershed in the central coast ranges of California. Water yield, flood peak, sediment yield and water quality will be monitored on a small watershed before, during, and after urbanization. Concurrent with the measurement of these stream characteristics, precipitation and soil moisture levels will be measured.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

6.0167, STOCHASTIC HYDROLOGY

H.E. KUBIK, U.S. Army, Hydrologic Engineering Center, Davis, California 95616

Analysis of multipurpose reservoirs and reservoir systems indicates need for examining a great many ways that floods can occur in combination with antecedent streamflow sequences over a period of many months or years. The number of such combinations in a record of ordinary length is extremely small, consequently there is a great need in water resources studies for a method of generating synthetic floods in conjunction with monthly streamflow generation, and for a new approach to estimating magnitudes and frequencies of large flood events (only a few of which are observed in an ordinary streamflow record). Short-interval streamflow simulation is a promising approach to satisfying this need.

Probably the greatest uncertainty in the planning and operation of water resource projects is the uncertainty of future hydrologic conditions. In planning studies it is frequently assumed that analysis of historical events will provide a satisfactory basis for evaluation of future performance. This assumption has been necessary because of the lack of satisfactory alternatives.

The goal of this research is to obtain a completely valid model for generating monthly streamflows particularly for use in the planning process. Once this capability is available, similar studies for simulating short-term hydrologic variations may be undertaken.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0168, PERRIS VALLEY URBAN HYDROLOGY STUDY, CALIFORNIA

M.W. BUSBY, U.S. Dept. of the Interior, Geological Survey, Garden Grove, California 92643

Land use of about 85 square miles in the Perris Valley area is in the process of being changed from primarily agricultural and minor urban, to primarily urban and minor agriculture. A master plan for land use is being prepared by Riverside County and will be utilized to guide urban development in the valley. County officials recognize the need for appraising the effects of the drastic changes in land use on the hydrology of the valley.

The Riverside County Flood Control and Water Conservation District has requested the geological survey undertake an investigation to determine: (1) The basic hydrologic character of the area under present conditions; (2) Effects of urbanization on runoff characteristics, sediment production, and water quality; and (3) insofar as possible, the relation of different land use to observed changes. The results of these studies will be used in future planning in other areas in the county.

Selected sub-basins in the valley will be instrumented to measure water and sediment discharge, precipitation, and chemical quality, on the basis of existing land use and likelihood of change during the next decade. With county assistance and periodic aerial photography, records of land use will be maintained on small land units; and automated system (punch cards) will be developed to record changes. In about the fourth year, a progress report will describe the existing hydrology of the area and preliminary findings.

San Diego County, as part of the growing southern California megalopolis, has recognized the need for knowledge of the changes in the hydrologic regimen with expected changes in land use. In southern California, both sedimentation and floods are the major hydrologic problems, thus urbanization accentuates the problems.

The county wants an appraisal of the hydrology, particularly rain-fall-runoff relationships and sediment yield during floods; before and after urban development. Urbanization creates erosion and sediment problems of unknown magnitude in San Diego County. This study is to determine the cause and effect relationship with possible application to other developed areas within the county. This study would provide information useful in (1) assessing the magnitude of the erosion during the period when an area is urbanized, (2) the establishment of controls (zoning and construction) to keep erosion to a minimum, and (3) evaluation of an erosion control program if undertaken by the county.

Obtain rainfall, sediment yield, and runoff data for 7 typical areas. Document land use and changes in use with time, also changes in ground-water regimen, and in channel characteristics. Sample chemical quality of ground and surface water annually. A progress report will be prepared to describe the existing hydrology of the area and to report on preliminary findings. The time period should be flexible, but some type of progress report should be written probably within a couple of years. Tentatively the investigation would continue for ten years or if land use changes occur more rapidly, a shorter period.

Basic data network established and background information collected (streamflow, sediment loads, precipitation, land use). Investigating the applicability of different types of modeling.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0170, GLENDORA, CALIFORNIA, GENERAL PLAN 1990

UNKNOWN, Glendora City Government, Glendora, California

Abstract: The General Plan report for the City of Glendora, California is composed of six chapters. Chapter I presents the framework for planning in Glendora and indicates the purpose of the plan. Chapter II reviews and analyzes the background data concerning the planning area. Chapter III discusses the goals and objectives of the plan. Chapter IV presents the elements of the General Plan including land use, circulation and community facilities. Chapter V indicates recommended implementation techniques which can be used to put the plan proposals into effect. Chapter VI contains the total geologic report.

Pub. Sep. 70: 166 p., NTIS No. PB-196 067: PC \$3.00 MF \$0.95.

SUPPORTED BY No Formal Support Reported

6.0171, CLOUD SEEDING POTENTIAL FOR TWELVE RIVER BASINS

R.D. ELLIOTT, North Amer. Weather Consult., Goleta, California 93017

Evaluation of historic potential for increasing precipitation

Purpose of study/investigation: To investigate flow conditions and determine adequacy of the design of the various structures included in the plan.

Progress to date: The East Twin and Warm Creek improvement consists of three parts. The study on the rock-lined transition was completed in 1961 and reported in Los Angeles District Report No. 1-105 dated 1961. The confluence model study for East Twin and Warm Creeks and City Creek will be included in the combined Flow at Open-Channel Junctions report now in progress. The third model study is a low-flow diversion structure in a concrete-lined rectangular channel. This third study will be combined with other diversion structure studies.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0173, COMPUTER SIMULATION MODEL FOR FLOOD PLAIN DEVELOPMENT - PART II - MODEL DESCRIPTION AND APPLICATIONS

N.V. ARVANITIDIS, I N T A S A Incorporated, Menlo Park, California 94025

Abstract: The report presents a simulation model for the evaluation of national economic efficiency benefits of various levels of flood protection and alternative land use plans. The model has three major components: (1) Calculation of flood damages and economic rent components. (2) Allocation of land use requirements. (3) Benefit calculation based on locational advantage and damage reduction. The report also presents the results of a test case in Connecticut River Basin.

Pub. Dec. 72: 155p., NTIS No. AD-765 499/9: PC \$9.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0174, COMPUTER SIMULATION MODEL FOR FLOOD PLAIN DEVELOPMENT - PART I - LAND USE PLANNING AND BENEFIT EVALUATION

N.V. ARVANITIDIS, I N T A S A Incorporated, Menlo Park, California 94025

Abstract: The publication presents analytical progress in the development of a computer simulation model for flood plain development. A conceptual model was developed for five major parts: forecasting population and economic activities; allocating activities to available land; integrating public policies restricting land use; measuring and projecting flood damages; and evaluating benefits based on appropriate formulas involving flood damages, land rents, and locational advantages. Several concepts are introduced to solve problems associated with development of the simulation model.

Pub. Feb. 72: 87p., NTIS No. AD-742 295: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0175, PLAN FORMULATION AND EVALUATION IN MULTIPLE PURPOSE WATER RESOURCE PROJECT - A FRAMEWORK FOR REGIONAL PLANNING (ABBREV)

LIJSEN, I N T A S A Incorporated, Menlo Park, California 94025

The overall objective of the proposed research is to present an integrated approach to plan formulation and evaluation for planning multiple purpose water resource projects. Specifically to: (a) Demonstrate that a meaningful methodology for

enable plan formulation to take particular problems and potentials of resource development. This will require characterization of the area affected by a set of regional indicators directly in contact. (3) Demonstrate that plan formulation must explicitly account for alternate uses of the affected area and extend current models to include aspects of flood damage, recreational, aesthetic and ecological.

SUPPORTED BY U.S. Dept. of Interior

6.0176, FLOODS FROM SMALL RIVERS IN CALIFORNIA

A.O. HAANANEN, U.S. Dept. of the Interior, Menlo Park, California 94025

The paucity of data on the magnitude and frequency of floods in small drainage areas in California and economic design of structures in these areas. Thus, an urgent need exists for interpretation of such data.

To obtain sufficient basic hydrologic data on the magnitude and frequency of floods on a statewide basis, and to obtain sufficient data for detailed hydrologic studies.

Collect flood-flow data on about 300 small rivers in the state, obtaining annual peak discharge data at a limited amount of precipitation at about 125 stations. After gathering data for about 15 years, a regional analysis of the frequency of floods will be made. This will be done by analyses by branch of computation and by the required during the regional flood frequency studies.

From data collected as scheduled, a regional analysis of data at all stations, flood-hydrographs, and data for stations equipped with recorder. Results (maximum events) have been obtained. Simulation techniques for extended periods have been tested.

Data-collection program and flood-frequency studies continued. Summary of data will be prepared. Final report summarizing flood-frequency program will be prepared.

SUPPORTED BY U.S. Dept. of Interior

6.0177, PROCEDURES FOR ANALYSIS OF FLOOD FLOWS FROM SMALL RURAL WATERSHEDS

R.K. LINSLEY, Hydrocomp International

Abstract: Flood frequency curves were compared with those observed for 40 watersheds representing a wide range of geographical conditions in this country. In the literature, four methods were selected for comparison: HSP, Regional, Potter's method, and extreme value straight line fitting method. Digital computer method appears to be have effect on frequency curve as indicated by the results for the watersheds. Further researches to determine characteristics and to intensively simulate flood frequency curves are suggested for the watersheds.

6.0178, NORTH RICHMOND - SAN PABLO BAY AREA STUDY - CALIFORNIA

J.P. KENNY, Council on Intergov. Relations, Sacramento, California 95814

Abstract: The report focuses on long-range physical development for a low-income minority community located in an urban floodplain. It deals with inadequate flood protection, storm drainage, air and water pollution, and lack of cultural and recreational facilities. It defines opportunities for extensive marshland preservation, outdoor environmental education, recreation, public access to the Bay, and economic development. A unique feature is its inter-agency, multi-purpose approach to plan development.

Pub. Oct. 71: 81p., NTIS No. PB-211 777: PC \$6.25 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0179, GENERAL PLAN REPORT, LAKE RED BLUFF AREA, CALIFORNIA, 1971

UNKNOWN, Council on Intergov. Relations, Sacramento, California 95814

Abstract: Studies and recommendations are reported for the Lake Red Bluff area of California as related to land use, circulation, recreation, conservation/open space, and regulatory measures. Included in addition are recommendations for improved flood plain protective measures, water surface use regulations, and design improvement, along Lake Red Bluff.

Pub. Aug. 71: 54p., NTIS No. PB-210 880: PC \$4.75 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0180, FLOOD-FREQUENCY RELATIONSHIPS FOR SMALL DRAINAGE AREAS - VIRGINIA

F.M. MILLER, U.S. Dept. of the Interior, Geological Survey, Sacramento, California 95814

Most stream-flow records in Virginia are for areas of more than 50 square miles. Additional records are needed from smaller areas in order that flood-frequency relationships may be developed. This information is badly needed for use in bridge and culvert design.

To determine flood frequencies for small drainage area sites in Virginia.

Flood-hydrograph and rainfall recorders will be installed at about 100 sites throughout Virginia. These will provide flood volume data as well as peak discharge data. The daily rainfall runoff model will be used to extend records back in time on basis of rainfall. Data will be published in open-file report after approximately 10 years of record collection.

Peak stages and discharges published in annual water resources of Virginia.

Continue collection of flood peak and rainfall data; tabulate and compile data.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0181, DRAINAGE AND FLOOD CONTROL BACKGROUND AND POLICY STUDY - SUMMARY REPORT

UNKNOWN, San Diego Reg. Comp. Pl. Org., San Diego, California 92101

to-date inventory of pertinent drainage and flood control information prepared in this study will be used as a basis for developing a regionwide plan and program. In general, the study presents physical descriptions for eight major drainage basins; analyzes urban growth factors as a part of the drainage and flood control problem; and suggests some seven possible alternative organizational arrangements for carrying out flood control work for the region.

Pub. May 70: 50p., NTIS No. PB-196 840: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0182, SEA COAST PLANNING PROJECT - CALIFORNIA

C. HETRICK, Univ. of California, School of Letters, Santa Barbara, California 93106

Objectives: The objective of this project is to provide basic data, plan formulation, and decision procedures to assist Santa Barbara County Planning Department in formulation and analysis of alternative plans for development of the county's sea coast to obtain optimal usage, both economically and environmentally, of the finite resources. The impact of beach pollution on the development of the channel coastline will be analyzed with particular reference to natural oil seeps. Analysis and classification of the flood-debris flow hazard across permanently settled piedmont alluvial fan surfaces along the county's South Coast, with attempt to assess benefits and costs to county or homeowners should such classification be implemented. A study will be made of California's South Coast tourist and retirement industries and of public policy concerning these to assess impact on expenditure, taxation, zoning and other political or economic restraints. Data gathered through survey will be processed to determine present recreational benefit use in Santa Barbara County and to predict future use and results. The development of the Channel Islands and the economic impact of oil production in the Santa Barbara Channel will be evaluated.

How information will be applied: Santa Barbara County can formulate coastal land-use plans with data on pollution impact on recreational, commercial, and residential uses made of the area. Geomorphic hazard classification will aid land-use zoning. Future beach demand can be met with informed planning and transportation patterns. County tax authorities will have data on oil production, land use, restrictive zoning, etc., on which to base realistic assessments. A comparative analysis of three proposed land use developments will be made available to decision-making bodies and will be of a nature useful for similar decisions in the future as well as for the present one.

Accomplishments during the past twelve months: 1. Fiscal data collected on Catalina and Santa Cruz Islands and boater data collected on local marinas. 2. Development of a model for estimating likely impact of differential tax rate structure of local taxing agencies on capital allocation by industry and area for a coastal zone. 3. Public opinion survey completed, verified open-ended questions coded, data key punched and preliminary analysis begun. 4. Pilot survey of Santa Barbara beaches completed.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0183, FLOOD HYDROLOGY INVESTIGATIONS

F.A. BERTLE, U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado 80225

6.0184,

Improvement of hydrometeorological and hydrological techniques to determine flood hydrology criteria for the design and operation of Bureau dams, canals, and related facilities. Meteorological records of observed storms are analyzed to improve methods for estimating maximum probable precipitation above reservoirs. Records of large flood events are analyzed to improve methods for estimating maximum probable floods and more frequent smaller flows.

SUPPORTED BY U.S. Dept. of Interior - Br. Reclamation

6.0184, DENVER METROPOLITAN AREA, COLORADO

R.M. LINDVALL, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Colorado.

The project objective is to prepare detailed general-purpose geologic maps of eight quadrangles covering the major part of the Denver metropolitan area. These maps, at a scale of 1:24,000, are designed to provide basic information on the geologic factors pertinent to maximum utilization of land in a rapidly expanding area of urban development. Information to be provided concerns the engineering properties of the surficial and bedrock units, location of potential hazards such as landslides, areas subject to flooding, areas subject to possible earthquake damage, areas of poor foundation conditions, and the location and extent of sand and gravel deposits necessary for construction aggregate materials.

The geologic maps, each including a brief descriptive text, are to be released first in open files and subsequently published in the Geologic Quadrangle Map Series. The geologic map of the Parker quadrangle was published in 1972 as the first sheet in a special Folio of the Parker quadrangle. Thirteen additional single-concept maps of the quadrangle have been or will be published in the near future to complete the Folio. The enthusiastic acceptance of the Parker Folio by planning commissions and public officials have prompted plans to issue some similar interpretive maps for the adjoining Highlands Ranch quadrangle.

A comprehensive geologic report covering all eight quadrangles is planned for the Bulletin series.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0185, MOUNTAIN SOILS, FRONT RANGE URBAN CORRIDOR

K.L. PIERCE, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Colorado.

The prime objective is to prepare maps showing the distribution, thickness, and infiltration characteristics of the regolith mantling hard crystalline rock in the mountainous part of the Front Range Urban Corridor. The map units will be defined to provide information concerning the suitability of the regolith (soil) for disposal of septic tank effluent without surface or ground water contamination, and the depth of excavation possible by power machinery without recourse to blasting. Also mapped (with Water Resources Division) will be the areas affected by flash floods, seasonally saturated ground, and landslides.

Mapping will be done for publication at a scale of 1:100,000 in a period of about 2 years. Water-well logs and a small

6.0186, PEAK DISCHARGE AND SMALL WATERSHEDS IN COLORADO

UNKNOWN, U.S. Dept. of the Interior, Denver, Colorado 80225

The flood characteristics of small watersheds are poorly defined. Existing techniques for estimating magnitude and frequency of floods are applicable to large drainage areas. Also, estimates based on unit hydrographs are crude since data is lacking.

The objective of this study is to collect data and develop techniques for estimating the magnitude and frequency of floods on small watersheds. Emphasis is on the greatest degree of accuracy on watersheds of the interstate highway network where the importance of the economic significance in the design of bridges and culverts. Consideration will be devoted to research aspects of techniques.

The data for this project will be collected from stage-rainfall recorder installations distributed throughout the state so as to sample typical hydrologic environments. Data from the present streamflow network and the Federal Bureau's Precipitation Network in Colorado will be included in the analyses. Field reconnaissance trips to select sites, install recorders, making measurements of flow, and determining watershed parameters. Office research on technique development and analysis.

1) Operation of 43 rainfall-runoff stations continued. 2) Completed basic data release of rainfall-runoff data collected through September 1971. 3) Storage of data at 4 stations for subsequent use in the full-runoff model. 4) Basin size, channel characteristics, and shape determined for 19 basins.

1) Continue operation of 43 rainfall-runoff stations in Colorado. 2) Continue definition of basin characteristics. Begin preliminary evaluation of HSCIS model.

SUPPORTED BY U.S. Dept. of Interior

6.0187, FLOOD FREQUENCY IN SMALL WATERSHEDS IN COLORADO

UNKNOWN, U.S. Dept. of the Interior, Denver, Colorado 80225

The frequency of peak flood flows is an important factor in designing urban drainage works. Data for small watersheds and estimates made from unit hydrographs are to be substantially in error. The aim is to collect data on small areas and develop rainfall-runoff relationships. The data will be interpolated to all small watersheds in the six-county area.

1. To collect data useful in defining relationships between rainfall intensity and duration of storms in the six-county area which includes Arapahoe, Boulder, Denver, Douglas, El Paso, and Jefferson counties. 2. To study and develop techniques for estimating peak flood flows in both in time and space.

We propose to collect rainfall and runoff data for a representative sample of drainage basins in the 6-county area. The basins will be selected to sample the following ranges of drainage area, peak flow, and frequency of occurrence.

MAJOR DISASTER TYPES

outflow from each basin, supplemented by crest gages to record peak stages at other locations.

- 1) Operation of 30 rainfall-runoff stations in Denver metropolitan area continued
- 2) Completed basic-data release of all rainfall-runoff data collected through September 1971.
- 3) Began computer storage of data at 2 stations for subsequent use in USGS rainfall-runoff model.
- 4) Began preparation of basic-data release for the May 5-6, 1973, storm in the Denver area.

- 1) Continue operation of 30 rainfall-runoff stations in Denver metropolitan area
- 2) Begin definition of basin characteristics such as drainage area, percent impervious cover, and channel slope.
- 3) Complete report on May 5-6, 1973, storm.
- 4) Begin preliminary calibration of USGS model on 2 basins.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0188, HAMILTON 2 DEGREE

J.D. WELLS, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Montana and Idaho.

Prepare a geologic map of the Hamilton 2-degree sheet at 1:250,000 scale, integrating the past, current, and future pertinent mapping done by industry, universities, and State and Federal agencies, and incorporating geologic, geochemical, isotopic, and geophysical data as a basis for evaluation of land use and mineral potential. Special purpose interpretative maps and reports will be prepared of appropriate areas where potential hazards such as landslides, unstable foundation material, faulting, earthquakes, and flooding are present. An evaluation of known and potential mineral resources of base and precious metals and fluorite along the margins of the Idaho Batholith and stratabound copper in the Belian strata will be made. These data will contribute to the general body of geologic knowledge of the northern part of the Idaho Batholith and contribute in developing the regional structural, stratigraphic, magmatic, metamorphic, and erosional patterns. They will further provide a proper basis for land use planning for the diverse interests in this area of urban development in an outstanding recreational area.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0189, INVESTIGATION FOR FLOOD PROTECTION OF BRIDGES

D. SIMONS, Colorado State University, School of Engineering, Fort Collins, Colorado 80521

Objectives: 1. Channel stabilization in the vicinity of and downstream of culvert outlets. 2. Channel stabilization in the vicinity of and downstream of bridges. 3. The use of special methods and techniques where there is no gravel or rock and where special problems arise.

Approach: Utilized three different sizes of laboratory flumes to obtain data. Subsequently, limited field data were collected to help establish validity of results.

SUPPORTED BY Wyoming State Government - Cheyenne

6.0190, HYDROLOGY OF SMALL WATERSHEDS

V. YEVJEVICH, Colorado State University, School of Engineering, Fort Collins, Colorado 80521 (2R23231413)

A systematic way of assembling, storing, and recalling data from gauging stations on small watersheds has been

version to housing subdivisions, various aspects of erosion, etc. It has been shown that much of the flood data can be clearly related to change in the response of the watershed. The Colorado State University watershed data file has been expanded to include urbanized watersheds and floods resulting from snowmelt.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY Colorado State University - Fort

6.0191, SOCIALLY DEFINED ENVIRONMENTAL VALUES IN URBAN WATER RESOURCES PLANNING

D.W. HILL, Resources Development Consult., Fort Collins, Colorado 80521 (C-4222)

This research seeks to develop objective social criteria in developing and employing evaluating procedures that account for trade-offs and interactive effects of environmentally related social values. The values will be identified, then incidence and intensity rates measured on the basis of data drawn from three stratified urban samples. One sample will be located in a short water area, one in a plain water area, and the last in a modestly short-water area. Values to be identified and measured include water quality values, attitudes toward effluent, recreation values, personal and aesthetic amenity, and flood plain management and flood control values.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Div.

6.0192, RECOMMENDED REGIONAL PLANNING FOR SEWERAGE, WATER SUPPLY AND STORM DRAINAGE - CONNECTICUT

UNKNOWN, Valley Regional Planning Agency, Ansonia, Connecticut 06401

Abstract: The report presents the recommended plan and program for sewerage, water supply and storm drainage for the 58 square mile Valley Planning Region, Ansonia, Derby, Seymour, and Shelton, Connecticut. Pub. Feb. 70: 92p, NTIS No. PB-192 940: HC \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0193, SMALL STREAM FLOOD CHARACTERISTICS

M.D. THOMAS, U.S. Dept. of the Interior, Geological Survey, Hartford, Connecticut

Records of streamflow are relatively plentiful on medium and larger streams in Connecticut. However, records on small streams, especially those below 10 square miles, are extremely limited. There is an immediate need for more information on the magnitude and frequency of flood discharges on these areas. Project should continue until at least 10 years of record have been completed.

To provide flood flow information at many new sites in Connecticut on streams with small drainage areas. Use information to supplement similar information at other sites. Obtain continuous records to improve or develop a new formula for Connecticut based on basin characteristics.

Establish and maintain a crest-stage gage network in Connecticut and prepare a stage-discharge rating station. Analyze records of annual peak discharges with respect to frequency, regional characteristics, drainage

ing 1973 data. Continuation of flood frequency analysis.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0194, ANALYSIS OF LAND USE CONTROL MEASURES

W.D. ANDERSON, U.S. Dept. of Agriculture, Natural Resource Econ. Div., Washington, District of Columbia 20250 (NRE3-3-54-00)

Objective: Appraise the status of and analyze developments in rural zoning enabling statutes and zoning ordinances, and analyze what is being done under rural zoning ordinances.

Approach: Examination, analyses, and classification are made of all State rural zoning enabling statutes which empower counties, townships or other governmental units to adopt ordinances and regulations. Rural zoning ordinances and regulations enacted by local governmental units are collected, analyzed, and classified. Analyses are made of rural zoning as it relates to agriculture and natural resource uses. Special attention is directed at significant zoning innovations and related land use control techniques.

Progress: Substantial demands for staff assistance on land use policy issues continued. Preliminary analyses were made of techniques for preserving agricultural land. Several earlier reports resulting from this research project were reprinted.

SUPPORTED BY U.S. Dept. of Agriculture - E.R.S.

6.0195, KANSAS - NORTH SECTOR UPPER WALNUT WATERSHED BUTLER AND CHASE COUNTIES

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: A watershed project is to be carried out in Butler and Chase Counties, Kansas. The project proposes conservation land treatment over the two watersheds, supplemented by 30 floodwater retarding structures. Project action will: eliminate agricultural use and wildlife habitat of 1,115 acres of cropland, grassland, and woods in the sediment pools; inundate about 18 miles of intermittent stream channels; and interrupt agricultural and wildlife uses of 3,349 acres in the planned detention pools.

Pub. Mar. 72: 64p., NTIS No. PB-200 794-F; PC \$3.10 MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

6.0196, UNION CREEK WATERSHED PROJECT, SOUTH DAKOTA

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The Union Creek watershed for flood control and land stabilization is located in Union County, South Dakota. Adverse environmental effects which cannot be avoided are about 5 miles of intermittent stream channel, 40 acres of cropland, and 55 acres of grassland which will be inundated by the sediment pools. Agricultural and wildlife use will be periodically interrupted in the floodwater detention pools. The use of 50 acres of land in dams, spillways, and grade stabilization structures will be temporarily lost to agricultural and wildlife until the areas are re-vegetated.

Pub. Feb. 72: 31p., NTIS No. PB-206 620-F; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

Abstract: The Hollow Creek Watershed Project, located in Lexington and Saluda Counties, South Carolina, proposes conservation land treatment over the watershed, supplemented by two floodwater retarding structures. Adverse environmental effects include the following: The impoundment will destroy agricultural use and wildlife habitat on four acres of pasture land and 87 acres of woodland; The retarding pools will periodically interrupt agricultural and wildlife use on an additional 16 acres of pasture land and 125 acres of woodland; Increased vehicular traffic will occur in the vicinity of the floodwater retarding structures; One and one-half miles of stream channels will be inundated.

Pub. Oct. 71: 10p., NTIS No. PB-203 233-D; PC \$3.00.

SUPPORTED BY U.S. Dept. of Agriculture

6.0198, KANSAS - NORTH SECTOR UPPER WALNUT WATERSHED BUTLER AND CHASE COUNTIES

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The projects propose conservation land treatment over two watersheds, supplemented by 30 floodwater-retarding structures. The combined project area for the North and South Sector Upper Walnut River Watershed plans consists of about 282,000 acres and is located in Butler and Chase Counties, Kansas. Approximately 18 miles of intermittent stream channels will be inundated by the planned sediment pools. Agricultural use and wildlife habitat in the 1,115 acres to be occupied by the sediment pools will be lost. Agricultural and wildlife use of the 3,349 acres in the detention pools will be periodically interrupted by floodwaters. Agricultural and wildlife use in the 220 acres to be occupied by dams and spillways will be lost until vegetation is established immediately after construction. There will be project induced evaporation losses in the sediment pools which can reduce low flows in stream reaches below the reservoirs if releases are not made during periods of low flow as required by the Kansas Division of Water Resources.

Pub. Jul. 71: 16p., NTIS No. PB-200 794-D; PC \$3.00.

SUPPORTED BY U.S. Dept. of Agriculture

6.0199, NUTWOOD WATERSHED, ILLINOIS

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: A watershed project to be carried out in Jersey and Greene Counties, Illinois by three sponsoring local organizations with federal assistance will include land treatment measures supplemented by three floodwater retarding structures, two water level control structures, and one pumping station. The land treatment program will reduce average annual upland erosion, promote more efficient land use, and reduce water runoff. Combined land treatment and structural measures will reduce sediment and flood water damages. Forty-eight hundred acres of bottomland will benefit from flood control, improved drainage, and more intensive land use. Approximately 40 acres of lake fishery and aquatic habitat will replace 40 acres of pasture. Approximately 37 acres of woodland and pasture will be periodically inundated by flood detention pools. Construction of the dams and spillways will temporarily disturb or destroy the vegetative cover on an additional 38 acres.

Pub. May 72: 24p., NTIS No. EIS-IL-72-5155-D; PC \$3.25.

SUPPORTED BY U.S. Dept. of Agriculture

6.0200, HURRICANE CREEK WATERSHED STRUCTURAL PROJECT MEASURE, KENTUCKY

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The proposed project measures consist of accelerating the on-going land treatment program, installing three floodwater retarding structures, and improving about four miles of channel in Hopkins County, Kentucky. The project will take 48 acres of agricultural and forestry land for sediment pools and structure areas, disrupting or temporarily delaying the use on another 126 acres in the flood pools and other affected areas, and increase the potential for problems associated with population growth and economic expansion.

Pub. Jan. 72: 30p., NTIS No. PB-203 511-F: PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Agriculture

6.0201, CDRNUDAS, NORTH AND CULP DRAWS WATERSHED, HUDSPETH COUNTY, TEXAS, AND OTERO COUNTY, NEW MEXICO

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The project consists of land treatment and floodwater retarding structures in Hudspeth County, Texas, and Otero County, New Mexico, for the purpose of watershed protection and flood prevention. Environmental effects are generally beneficial. Agricultural production will be eliminated or interrupted on considerable acreage.

Pub. Nov. 72: 56p., NTIS No. EIS-NM-72-5708-F: PC \$5.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

6.0202, BIG CREEK WATERSHED, KANSAS

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The project located in Coffey, Lyon, Greenwood and Woodson Counties, proposes conservation land treatment over the watershed supplemented by nine floodwater-retarding structures. The project action will: reduce floodwater and sediment damages on 8,350 acres of flood plain land; Reduce erosion; Provide 148 surface acres of water for fishing, recreation and feeding and resting areas for migratory waterfowl at the sediment ponds of planned floodwater-retarding structures; Eliminate agricultural and wildlife use of 340 acres in the sediment ponds; Inundate about 8 miles of intermittent stream channel.

Pub. Jun. 71: 32p., NTIS No. PB-200 808-F: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

6.0203, MACADOO ROAD-FILL DAM, KANSAS

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The statement presents information for the MacAdoo Road-Fill Dam, project located on Elm Creek, a tributary of the Medicine Lodge River. The project measure area consists of 39,617 acres and is located in Barber and Pratt Counties, Kansas. The project will retard runoff, reduce soil erosion, sedimentation, give 35 farms flood protection benefits on 1,290 acres, provide fishing, and reduce the sediment of the stream. The adverse environmental effects would be the tem-

6.0204, STARKWEATHER WATERSHED, NORTH DAKOTA

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The project is located in Ramsey and Cavalier Counties, North Dakota and proposes conservation land treatment over the watershed, supplemented by 60.6 miles of channel improvement for flood prevention and agricultural water management. Channel improvement will drain 345 acres of Types 3, 4, and 5 wetlands. One hundred and five acres of upland habitat will be destroyed by channel improvement. Groundwater recharge will be reduced. The man-made appearance of the constructed channels will not be as in their natural undisturbed state. Wildlife systems now existing in the area of the proposed channel construction will be altered. The potential exists for local interests to extend the project measures to drain the equivalent of 4,000 acres of existing wetlands not preserved by easement or purchase.

Pub. Aug. 71: 10p., NTIS No. PB-202 150-F: PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Agriculture

6.0205, VERDE LANE FLOOD PREVENTION PROJECT MEASURE, NEBRASKA

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The following statement presents information on the Verde Lane Flood Prevention Project located South of the Town of Sidney in Cheyenne County, Nebraska. The watershed covers an area of 542 acres with 138 acres in urban development, 292 acres of range land. The environmental impacts of the proposed project are: Conservation land treatment to limit erosion and sediment production to less than five ton per acre per year; Reduce by 75 percent delivery of sediment to Lodge Pool Creek; Eliminate floodwater damages from a 100-year storm; Reduce by 75 percent sediment transport to Verde Lane drain; Fenced in area will provide three acres of undisturbed nesting cover. The adverse environmental effects are: Agriculture production will be lost on four acres of embankment and spillway area; Temporary loss of wildlife habitat; Construction of the dam will disturb vegetative cover on approximately six acres.

Pub. May 71: 22p., NTIS No. PB-199 021-F: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Agriculture

6.0206, WHITEWATER CREEK HYDROLOGIC UNIT PROJECT MEASURE, CHERDKEE HILLS RC AND D PROJECT, OKLAHOMA

UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service, Washington, District of Columbia 20250

Abstract: The Whitewater Creek drainage basin comprising 19,738 acres (30.84 sq. mi.) is located approximately eight miles northeast of Jay, Oklahoma, in Delaware County. The 1,054 acres of floodplain land in the watershed are subject to frequent and severe flooding. Major floods covering more than half of the floodplain can be expected about once every three years. The project consists of conservation land treatment practices and three floodwater retarding structures. Conservation land treatment will reduce soil loss on the upland by approximately 10 percent. The completed project

scenery, this will be offset somewhat by re-vegetation of disturbed areas and by the addition of a body of water to the landscape.

Pub. May 71. 12p. NTIS No. PB-199 653-F. PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Agriculture

6.0207, LAKE HYDROLOGY

L. BAJORUNAS, U.S. Dept. of Commerce, Limnology Division, Washington, District of Columbia

Description: Data are being gathered and analyzed on water quantity factors, such as inflow, outflow, precipitation, and evaporation in order to obtain a better understanding of their interrelationships and their effects on the Great Lakes. Data related to ice and snow formation, accumulation, composition, and decay; time and areal distribution; and structural and crystallographic features are also acquired over the Great Lakes. These data are analyzed and then correlated with physical, hydrologic, and meteorologic conditions and forecasting methods developed. The water level and ice forecasts will enable the commercial navigation to utilize the full load capacity and to extend navigation into the winter. Water supply forecasts improve lake level regulation and provide information to shore property owners on potential flooding and erosion.

Technical objective: To develop or improve methods to forecast water supply, lake levels, and the formation, extent and breakup of ice cover.

Implementation: To accomplish its purpose, the task is broken down into the following Work Units for specific activities: Hydrologic Data Base; Lake Precipitation; Lake Evaporation; Ice Cover Distribution; Ice Characteristics; Ice Forecasting.

Part I of 7.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.

6.0208, HYDROLOGIC STUDY OF SMALL RURAL WATERSHEDS - INDIANA

COOK, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

The objective of this project is to develop an accurate method for estimating flood runoff of various recurrence intervals on small rural watersheds, with drainage areas of less than 20 square miles, in the state of Indiana.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0209, INVESTIGATION OF ERTS-A IMAGES FOR APPLICATION TO THEMATIC MAPPING, MISSISSIPPI RIVER

D.T. EDSON, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Abstract: The author has identified the following significant results. Theme extractions, enlarged to proper scale can prove a simple and convenient tool for evaluation of small scale map content, and as a guide to and for map revision. Open water extractions provide a graphic, easy to read, historical documentation of the recent Mississippi River flood at successive times during the flood period. Open water extractions, used in conjunction with swamp-wetland extractions, can be used to document and monitor temporal changes in wetland water levels.

Pub. Jul. 73. 5p. NTIS No. E73-10952. PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

J. HORTON, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Crest stage indicators have been installed on streams in Connecticut. The drainage area ranges from 1.20 sq mi to 10.4 sq mi and chosen to give wide coverage to the state and correlation of results with those from record primary gaging stations of the USGS. The data collected is determined from a study of and from the record of adjacent primary station discharge is computed from the characteristic way opening at the gage site and far from discharges made by USGS at times of flood. The project is expected to lead to a more accurate method of flows of streams having drainage areas of from 10 sq mi. Since the start of this program in floods at each of the long-term stations in Connecticut seldom exceeded the long-term mean annual of an extended period of drought in this area, estimates of long-term mean annual floods have been made at the crest stage sites under this program based on long-term mean annual floods to short-term floods at the long-term stations. These ten cannot be confirmed, however, until additional short-term mean annual floods more near long-term mean annual floods at the long-term stations. USGS is now re-analyzing data in an attempt to correlate short-term (8 yrs) to long-term floods.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Interior - Geol.

6.0211, HYDROLOGY OF OUTSTANDING

E.J. KENNEDY, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242 (2R2)

Research projects are being conducted in 4 states to collect and compile data on major and unusual floods. Analyze data from outstanding floods and findings of other research projects.

Document provided to S.S.I.E. by Highway Research Service.

SUPPORTED BY U.S. Dept. of Interior - Geol.

6.0212, INVESTIGATION OF SCOUR AT BRIDGES IN ALASKA

L.S. LEVEEN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242 (2R2)

Scour at bridges in Alaska is being studied at the field. Initially only reaches where a bridge is relatively straight section of the stream channel. The stream channel is surveyed downstream of the bridge. Cross sections and profiles of the stream bed are taken with an echo sounder. Hydraulic and transport variables include sediment size analysis, current meter-stage-discharge and depth-discharge relationships of suspended load, size analysis of bed material, velocity distribution at various stages, measurement of depth, and determination of the discharge-free. It is believed that analysis of the data will lead to predicting scour at bridges.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation

6.0213, FLOOD FREQUENCY OF ALABAMA RIVERS

U.S. Geological Survey Circular 342, Floods in Alabama, Magnitude and Frequency, has been updated and refined on the basis of 12 additional years of stream flow record. Flood frequency relations are being developed for small watersheds in Alabama on the basis of rainfall-runoff relations, long term weather records and physiographic factors.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0214. FLOOD FREQUENCY SYNTHESIS FOR SMALL STREAMS - ALABAMA

C.O. MING, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

This project is aimed at providing a method for estimating the magnitude of floods in watersheds of 1 to 15 square miles in Alabama. For several small watersheds, the functional relation between storm rainfall characteristics and peak flow on the basis of available records of rainfall and stream flow will be defined for each watershed. A long-term flood-frequency curve will be synthesized for each gaged watershed. These results will be extrapolated to ungaged watersheds by correlation with topographic and climatic variables.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY Alabama State Government - Montgomery

6.0215. FLOOD-FREQUENCY AND BASIN PARAMETER RELATIONSHIPS IN SMALL DRAINAGE AREAS

H.C. RIGGS, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Purpose: To determine the factors and physical relationships that control the frequency and magnitude of floods on small drainage basins (generally less than 15 square miles and many less than 2 square miles), and develop reliable methods for estimating peak discharges.

Methods: Depending on the climatic and other features of the particular region, various methods and combination of factors are analyzed and tested for reliability, based on past and current records of flood flow, or synthesized floods. These factors include basin shape, slope, geology, vegetative cover, land use, antecedent precipitation, runoff volumes, peak discharge, and rainfall intensity and duration.

Geographical scope: Work is being conducted in 35 states and Puerto Rico as part of the program of water resources investigations conducted by the Geological Survey in cooperation with the States.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0216. WATER RESOURCES INVESTIGATIONS

P.B. SAUER, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242 (2R23227353)

Analytical techniques, along with computerized capabilities, and the availability of 13 subsequent years of factual flood experience (1956-1971) make it appropriate to undertake a more detailed study of the parameter pertinent to prediction of flood magnitude. The study will utilize annual peak data published through 1971. Data for contiguous areas in adjacent states will be included as appropriate. The computer-data bank on annual flood peak discharges will be completed through the 1971 water year. The frequency relation of annual flood peaks of each gaged site will be computed on the

be related independently to various basin and hydrologic parameters using multiple-regression techniques. Because of the short length of records for areas of less than 50 square miles, only the 2-, and 10-year flood will be included in the multiple regression studies. However, techniques for estimating the 25- and 50-year floods will be provided. Results of the analyses will be studied in relation to geographic bias or other factors that might reasonably be expected to have some distinguishing influence on flood-peak runoff characteristics. Regions having similar flood-frequency characteristics will be delineated if necessary to minimize the standard statistical errors.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0217. INVESTIGATION ON ANALYSIS OF FLOODS FROM SMALL WATERSHEDS IN OKLAHOMA

B. THOMAS, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242 (2R23227354)

The magnitude and frequency of flood peaks in one to fifty square mile watersheds were investigated. 100 crest-state and recorder gauges were installed and library research was conducted. Flood discharges will be computed by hydraulic principles and flood characteristics will be studied.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0218. IMPROVEMENT IN FLOOD-FREQUENCY ANALYSIS

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Flood mapping is used in nationwide programs of flood-zoning regulation and flood insurance. The work is done by several federal agencies and, in adjacent areas, significant inconsistencies in the 100-year flood boundary, for example, occur despite general adherence to recommended guidelines for flood frequency-analysis. This is because alternate treatment is possible at several stages of the analysis. States and municipalities that administer the programs are concerned with the inconsistencies and have called attention to them in official quarters.

The objective is to resolve some of the major causes for differences in flood-frequency results. Specifically, the studies will attempt 1) To develop rules for elimination of outlying observations, high or low, that are not representative of the period of record, 2) To determine the best treatment of skew at a station, and 3) To determine the validity and proper use of the 'expected probability' adjustment.

The outlier problem will be studied by computer simulation. A national map of skew values will be prepared; alternative methods of using skew values (mapped or sample) will be tested for actual or simulated data, for both station curves and regional curves. The 'expected probability' adjustment will be tested against the results of multiple regression results now available.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0219. INVESTIGATION AND ANALYSIS OF FLOOD HYDROGRAPHS FROM SMALL DRAINAGE BASINS IN

any small watershed in South Dakota. The method derived will be used for design of highway culverts and small bridges. C. Schuerch, J. Polymer Sci. Part C, No. 36, P 231, 1971. 'Status of Ammonia Treatment of Wood and Wood Products', C. Schuerch, SUNY College of Environmental Science and Forestry Publication prepared for the 7th Cellulose Conference, 1971. 'Radial-Tangential Shrinkage of Ammonia-Treated Loblolly Pine Wood', R. A. Parham and C. H. De Zeeuw, Wood Science, 4:3:129, 1972.

Document provided to S.S.I.F. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0220, DEVELOPMENT OF HYDROLOGIC DATA NETWORKS IN URBAN AREAS

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Urban runoff must be managed for flood prevention and pollution abatement. Hydrologic data on rainfall-runoff-water quality relationships are urgently needed to assess management alternatives.

Development of a real-time urban data network to collect rainfall-runoff water quality data in urban environments.

Flow-measuring devices and associated instrumentation will be developed and adapted into an integrated real-time data network for collecting rainfall-runoff-water quality data in the San Francisco area.

A flow-measuring device has been designed and tested for measuring flow in pipes under open-channel and pressurized flow.

Continued collection of hydrologic data, possible expansion of data-collection network

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0221, PROGRAM DESIGN-1971 - SAN FRANCISCO BAY REGION ENVIRONMENT AND RESOURCES PLANNING STUDY

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Abstract: A comprehensive guide to a study of the 9-county San Francisco Bay Region describes a 4 year research-demonstration study conducted jointly by the Geological Survey and the Department of Housing and Urban Development, designed to improve urban development decisions and land-use planning through application of innovative earth science concepts. Urban-related environmental studies include: active faults and earthquake hazards, landslides and slope instability, physical and chemical properties of San Francisco Bay and its circulation patterns, water quality and pollution, areas subject to flooding, water supply and waste disposal systems, and available mineral and water resources. Planning program elements described include state-of-the-art review and analysis, a feasibility study of incorporating earth-science data into urban planning information systems, and application and demonstration studies.

Pub. Oct. 71: 121p., NTIS No. PB-206 826: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing and Urban Development

developed for predicting the magnitude and frequency of floods from any small watershed in South Carolina. The method will be used in highway culvert and small bridge design.

Document provided to S.S.I.F. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0223, STANDARDS FOR PLANNING WATER RESOURCES

UNKNOWN, U.S. Water Resources Council, Washington, District of Columbia 20037

Abstract: The document is a report on standards for uniformity and consistency by comparing, measuring, and judging benefits, costs, and alternatives.

Pub. Jul. 70: 296p., NTIS No. PB-209 176: PC \$0.95.

SUPPORTED BY U.S. Water Resources Council - D.C.

6.0224, A UNIFORM TECHNIQUE FOR DETERMINING FLOOD FLOW FREQUENCIES

UNKNOWN, U.S. Water Resources Council, Washington, District of Columbia 20037

Abstract: With the growing need for improved flood management, desirability of a basic, uniform method for establishing flood frequencies for general use throughout the Nation is manifest. A consistent approach to establishing the average annual value of flood losses--a major component in determination of the best measure of flood risk--combination of measures, in flood plain management, dependent upon equitable analysis of flood frequencies determined by Federal, State, local government, and private engineers. With this need in mind, the uniform technique for determining flood flow frequencies is set forth in this bulletin.

Pub. Dec. 67: 17p., NTIS No. PB-209 116: PC \$3.00.

SUPPORTED BY U.S. Water Resources Council - D.C.

6.0225, FLOOD HAZARD EVALUATION GUIDE FOR FEDERAL EXECUTIVE AGENCIES

UNKNOWN, U.S. Water Resources Council, Washington, District of Columbia 20037

Abstract: In order to provide equitable treatment of flood problems among Federal agencies, several Federal agencies established a work group to develop uniform guidelines and criteria for implementation of the executive order.

Pub. May 72: 26p., NTIS No. PB-210 850: PC \$0.95.

SUPPORTED BY U.S. Water Resources Council - D.C.

6.0226, REGULATION OF FLOOD HAZARD AND REDUCE FLOOD LOSSES - VOLUME I, PARTS I AND II

UNKNOWN, U.S. Water Resources Council, Washington, District of Columbia 20037

Abstract: This document is a report on the results of a study of flood hazard and flood losses in the United States. The study was conducted by the U.S. Water Resources Council, Washington, D.C., and the U.S. Army Corps of Engineers, Vicksburg, Mississippi. The study was completed in 1971 and the results are presented in this document. The document is divided into two parts, Part I and Part II. Part I contains a summary of the study and Part II contains the detailed results of the study.

UNKNOWN, U.S. Water Resources Council, Washington, District of Columbia 20037

Abstract: The report discusses the steps made toward development of a comprehensive water and related land resources management program for the region: regional courses of action toward effective management of flood plains, toward state leadership in coastal zone planning and management, and toward ways of making decisions about siting of electric power plants.

Pub. Jun. 71: 57p., NTIS No. PB-209 169; PC \$3.00 MF \$0.95.
SUPPORTED BY U.S. Water Resources Council - Wash., D.C.

6.0228, OHIO RIVER BASIN SURVEY, MAIN REPORT & DEVELOPMENT PROGRAM, COMMUNICATION FROM CHAIRMAN, U. S. WATER RESOURCES COUNCIL. (AB-BREV)

UNKNOWN, U.S. Water Resources Council, Washington, District of Columbia 20037

Abstract: The report describes a comprehensive program for water and related land use in the Ohio River Basin.

Pub. Jul. 71: 627p., NTIS No. PB-209 712; PC \$9.00 MF \$0.95.

SUPPORTED BY U.S. Water Resources Council - Wash., D.C.

6.0229, FLOOD HAZARD EVALUATION GUIDELINES FOR FEDERAL EXECUTIVE AGENCIES

UNKNOWN, U.S. Water Resources Council, Washington, District of Columbia 20037

The guidelines presented in this document have the primary purpose of assisting Federal executive agencies towards attaining equability in developing their own guidelines for the treatment of flood hazard problems when implementing Executive Order 11296.

The guidelines also provide agencies with basic policies and technical standards recommended for adoption when complying with Section 6 of the Executive Order, which states that each executive agency shall "... develop such procedures, regulations, and information as are provided for in, or may be necessary to carry out, the provisions of Section 1, 2 and 3 of this order".

Pub. May 72: 22p., No copy info. available.

Abstract provided by FDAA.

SUPPORTED BY No Formal Support Reported

6.0230, GEOHYDROLOGIC CONDITIONS AND FLOOD POTENTIALS IN THE SINK AREAS OF SOUTHWESTERN SEMINOLE COUNTY, FLORIDA

W. ANDERSON, U.S. Dept. of the Interior, Geological Survey, Ocala, Florida 32670

Water levels in the closed sinks in southwestern Seminole County, Florida, were much higher in 1960 than any observed prior to or since that time. Intensive development of the area has resulted in pressure to utilize some lands that lie below the high levels of 1960. In order to evaluate risks of flood damage to the development, the frequency of occurrence of the 1960 floods and of lesser floods needs to be established. Further, it is desirable to know the relations between the water levels in the sinks and the water table and

Stage records of water bodies in the sinks and of a lake resting on highly impervious materials will be collected. These records will be equated with rainfall and evaporation records to evaluate infiltration rates in the sinks. Rainfall records for the area will be analyzed to determine the frequency of the 1959-60 rainfall total. Water levels in wells will be measured.

Stage record for 4 sinks, 1 water-table lake and one artesian well were obtained to mean sea level datum. Peak stages for the 1960 flood were determined for some sinks. Rainfall records were analyzed to determine the frequency of the 2-year rainfall total for the period October 1958 to September 1960. Relative net seepage rates from lakes and sinks in the area were determined.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0231, SARASOTA - ZONING AND SUBDIVISION CONTROLS - REVIEW, ANALYSIS, AND RECOMMENDATIONS CONCERNING CURRENT REGULATIONS

E.R. BARTLEY, Tampa Bay Regional Plan. Coun., St. Petersburg, Florida

Abstract: Contents: Sarasota's authority to zone; The existing Sarasota zoning code (The legislative context, the judicial context, the executive); District regulations; Special problems-treatment of non-conformities; The current Sarasota zoning code; The current Sarasota subdivision regulations.

Pub. Jan. 70: 185p., NTIS No. PB-195 647; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0232, ZONING REGULATIONS OF THE CITY OF SARASOTA, FLORIDA

UNKNOWN, Tampa Bay Regional Plan. Coun., St. Petersburg, Florida

Abstract: The report is the new County of Sarasota, Florida Zoning Ordinance. The new regulations include modern zoning techniques such as performance standards, Planned Unit Development, Planned Industrial Districts, and site plan approval requirements. Provisions which are aimed at conservation and environmental protection are also inserted, such as landscaping and buffering, flood plain zoning, and tree protection requirements.

Pub. May 72: 164p., NTIS No. PB-211 746; PC \$10.25 MF \$0.95.

SUPPORTED BY Florida State Government - Tallahassee

6.0233, MAGNITUDE AND FREQUENCY OF FLOODS ON SMALL DRAINAGE AREAS IN FLORIDA

W.C. BRIDGES, U.S. Dept. of the Interior, Geological Survey, Tallahassee, Florida 32304

Previous studies have defined the flood characteristics of streams having drainage areas larger than 20 square miles, but similar data are lacking for small drainage areas in Florida. A significant part of the annual flood losses occurs on small streams. Small-stream culvert crossings represent approximately one half of the highway funds spent annually on drainage structures. Adequate information on flood characteristics of small streams will minimize flood costs through economic design of drainage structures and storage

of information needed to design drainage and flood-control structures, to establish realistic zoning ordinances, and to set equitable insurance rates.

At 30 to 40 small-basin sites, define the relationship between peak flow and storm rainfall from concurrent records of streamflow and rainfall collected over a period of 10 years (25 to 30 significant events). Using long-term rainfall records and the peak flow-rainfall relationship, synthesize a long-term flood-frequency curve for each gaged site. Derive by use of multiple-regression methods regional flood-frequency curves that can be applied at ungaged site.

Thirty-three gaging stations are currently in operation in the statewide.

Tabulate long-term daily evaporation data for Florida NWS Stations; Select outstanding storm-rainfall events and tabulate 5-minute unit rainfall for Jacksonville and Tampa. Run trial calibration for two small-basin stations in Northwest Florida.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0234, HYDROGRAPH MODEL STUDIES OF THE HILLSBOROUGH, ALAFIA, AND ANCLOTE RIVER BASINS, FLORIDA

J.F. TURNER, U.S. Dept. of the Interior, Geological Survey, Tampa, Florida

Moderate flooding in the lower Hillsborough River would cause considerable property damage to urban developments that are appearing on the immediate flood plain. Flood control structures have been proposed, and analytical methods, related to the operation of these structures, as well as flow simulation, are needed in ascertaining desired water levels in the lower Hillsborough. Flooding, associated with large regional storms, particularly hurricanes, could cause immense property damage and loss of life if advance flood warning is not provided to residents of critical low-lying areas in the Alafia and Anclote river basins.

(a) To develop a mathematical (computer) model of the Hillsborough River that simulates the entire streamflow hydrograph. The model would allow maintenance of desired water levels in lower reaches of the Hillsborough River. Provisions would be included for operation of a proposed system of flood control structures. (b) To develop mathematical (computer) models that simulate flood hydrographs at selected points on the Alafia and Anclote Rivers.

For the Hillsborough River, flood volume will be simulated in sub-basins by methods based on rainfall-runoff theory, accumulated at the main stream, and routed downstream through the flood control structures by use of energy and continuity equations governing flow in open channels. Base-flow component of the hydrograph will be approximated by empirical equations describing ground water discharge. Flow routing will be constrained by and dependent on desired water levels in lower regions of the basin. Flood hydrograph models based on rainfall-runoff theory, will also be developed for the Alafia and Anclote Rivers.

Progress during the year includes: (1) completion of report covering development of flood profiles of lower Hillsborough River; (2) realignment of streamflow, rainfall, and ground water monitoring network and installation of telemetry equipment at key streamflow station; (3) completed rainfall and evapotranspiration subroutines for basin model and determination of basin reservoir and channel routing parameters;

6.0235, FLOOD PLAIN STUDY AND MODELING OF THE EASTERN COASTAL AREAS OF PALM BEACH COUNTY, FLORIDA

UNKNOWN, Palm Beach Co. Area Plan. Bd. of Palm Beach, Florida 33404

Abstract: The report deals with the flooding problems of the Eastern Coastal Areas of Palm Beach County, Florida. Methods by which the more serious effects of flooding could be minimized or avoided. Sections of the report are concerned with the patterns of development in the County, a review of past flooding situations in the County, and the determining of flood criteria as established by the Corps of Engineers, U.S. Army. Also, the report discusses proposed Flood Hazard Ordinance criteria, a review of Flood Hazard District, Flood Proofing criteria, Subdivision and methods of controlling coastal flooding.

Pub. Mar. 72: 56p., NTIS No. PB-213 521/9: 1 \$0.95.

SUPPORTED BY Palm Beach County Government

6.0236, FLOOD PLAIN STUDY AND MODELING OF THE EASTERN COASTAL AREAS OF PALM BEACH COUNTY, FLORIDA

UNKNOWN, Palm Beach Co. Area Plan. Bd. of Palm Beach, Florida 33404

Analysis of past flooding conditions in Palm Beach County, a projection of future floods and recommendations for flood prevention measures.

This report deals with the flooding problems of the Eastern Coastal Areas of Palm Beach County and offers recommendations by which the more serious effects of heavy flooding could be minimized or avoided.

Sections II and III of the report are concerned with the patterns of development in Palm Beach County, a review of flooding situations in the Eastern areas and the determining of flood criteria as established by Corps of Engineers, U.S. Army. Past flooding studies conducted by various agencies are examined and early community participation in the Federal Flood Insurance Program is examined.

Section IV is basically an overview of the Federal Flood Insurance Program as presented in revised form in the Flood Insurance Act of 1968.

Section V analyzes the existing Flood Hazard Ordinance and Regulations presently in force in the County of Palm Beach.

Section VI presents proposed regulatory controls for flood damage in the urbanized areas of Palm Beach County. Included are proposed Flood Hazard Ordinance, Flood Hazard District, Flood Proofing criteria and methods of controlling coastal flooding.

Section VII summarizes the data presented in the report. The report is available from the County of Palm Beach, P.O. Box 1548, W. Palm Beach, FL.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0237, IMPLICATIONS OF ZONING AS A WATER MANAGEMENT MEASURE - GEORGIA

C.F. FLOYD, Univ. of Georgia, School of Business Administration, Athens, Georgia 30601

While restrictive zoning has frequently been used as a water management measure particularly in urban areas, it has not been widely recognized as a

ize a land-use simulation model being developed by the University of Georgia for the Georgia Department of Transportation to simulate land use pattern futures for various restrictive zoning policies. The alternative simulated future will then be compared to determine (1) the success of the zoning in achieving its desired goals, (2) the effect of the zoning on the total economy of the community, (3) the effect of the zoning on the distribution of economic welfare among the various regions of the state, and (4) the effects of the zoning on the environment. The study is to be coordinated with studies at other cooperating universities as part of a package evaluating social goals with respect to preserving open space and natural areas. The role of this study is to provide insights into the consequences of the open space preservation policies suggested as appropriate by the companion studies.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0238, SYNTHESIZING A PROCEDURE FOR FORMULATING URBAN FLOOD CONTROL PROGRAMS

L.D. JAMES, Georgia Inst. of Technology, Environmental Resources Center, Atlanta, Georgia 30332

Flood damages can be reduced by structural measures designed to contain runoff, nonstructural measures designed to reduce human activity in hazard areas, and land treatment measures designed to reduce runoff. Formulation of a combination of measures appropriate for a given situation should consider: 1) economics, 2) the hydrologic consequences of land use patterns, 3) the perceptions and desires of the affected public, 4) the interactions of the well-being of urban society with natural areas, and 5) the ecological values of the flood plain.

The principal investigator's previous exploration of the first four factors has produced a computer program for determining a least cost solution and methodologies and findings related to dealing with hydrologic factors, social forces tending to flood plain settlement, and effects of access to open land on urban well-being and local government. This research aids a group of ecologists.

The research procedure is to 1) consolidate the five methodologies into a form for easy explanation to and application by planners, 2) select four flood hazard case studies for applying the methodologies, 3) present the package to a graduate class containing experienced planners to study the workability and the results of the technique, and 4) integrate the total information obtained into a comprehensive flood planning package for general use.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Reh.

6.0239, THE FLOOD PLAIN AS A RESIDENTIAL CHOICE - RESIDENT ATTITUDES AND PERCEPTIONS AND THEIR IMPLICATIONS TO FLOOD PLAIN MANAGEMENT POLICY

L.D. JAMES, Georgia Inst. of Technology, Environmental Resources Center, Atlanta, Georgia 30332

Abstract: Various levels of decision making affecting settlement in flood plains are analyzed from the viewpoints of individuals seeking a residential location, individuals engaged in land development and construction activity, and individuals charged with forming and government. A concep-

Pub. Oct. 71: 309p., NTIS No. PB-206 424: PC \$6.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0240, THE PEACHTREE CREEK WATERSHED AS A CASE HISTORY IN URBAN FLOOD PLAIN DEVELOPMENT

L.D. JAMES, Georgia Inst. of Technology, Environmental Resources Center, Atlanta, Georgia 30332

Abstract: Historical development in the Peachtree Creek flood plain and watershed, metropolitan Atlanta, Georgia, and the reactions of planning officials, changes in water quality and land values are analyzed to ascertain the implications of historical experience for improved flood plain management policy. The report presents the historical sequences and causes and the role of governing officials in influencing development in the watershed from the time of earliest settlement, stressing flood plain development; analysis of the relative values of undeveloped lots on and off the flood plain and discusses the extent to which observed differences are caused by expected flood damages as opposed to differences in other residential choice factors; changes in stream water quality associated with urbanization and assessment of the magnitude of the problem created by storm water washing of urban areas, even if no sanitary sewer effluent is discharged directly into the stream.

Pub. Oct. 71: 93p., NTIS No. PB-206 427: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0241, TRAVEL TIME OF GEORGIA STREAMS

A.M. LUMB, Georgia Inst. of Technology, Environmental Resources Center, Atlanta, Georgia 30332

Abstract: Estimates of the time of travel of flow in natural streams are important to the hydrograph routine necessary for the planning and operation of flood control systems and to the routing of pollution movement needed for water management programs. Such estimates are particularly important when reacting to accidental spills that can contaminate downstream water supplies. This study develops, through multiple regression analysis of data on Georgia streams, prediction equations more accurate than current office approximations and less costly than tracer or other field studies. From the limited data available, it appears the equation for average velocity tends to underestimate travel times at high flows and over-estimate travel times at low flows. Only data for the north central and northwestern portions of Georgia were available for comparison.

Pub. Sep. 73: 90p., NTIS No. PB-224 848/2: PC \$6.50 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0242, THE EFFECTS OF LAND USE CHANGE ON THE HYDROLOGY OF AN URBAN WATERSHED

J.R. WALLACE, Georgia Inst. of Technology, Environmental Resources Center, Atlanta, Georgia 30332

Abstract: Historical changes in the pattern of land use and the effect of these changes on floods along Peachtree and Nancy Creeks, streams flowing through metropolitan Atlanta, Georgia, are analyzed and discussed. Land-use patterns in the watershed were determined at several points in time. Rainfall

and significantly increased the peak runoff from summer storms.

Pub. Oct. 71: 79p., NTIS No. PB-206 426; PC \$3.00 MF \$0.95.
SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0243, A PROGRAM FOR METROPOLITAN WATER MANAGEMENT

G.E. WILLEKE, Georgia Inst. of Technology, Environmental Resources Center, Atlanta, Georgia 30332

Abstract: Study objectives were to describe metropolitan water management; determine strengths and weaknesses of institutional arrangements; evaluate means of financing water programs; and suggest ways management could be improved. Field studies were done in Macon, Georgia, Lansing, Michigan, Charleston, Columbia, and Greenville, South Carolina. Emphasis was placed on differences among areas in terms of physical, economic, and political context. Depth interviewing was employed for 190 public officials, citizen groups, and general informants. Water management included water supply, wastewater management, storm drainage, flood hazard reduction, and recreation. Water management is treated as a social process. Roles of participants, nature of decisions and nondecisions, actions and inactions, functional priorities, intergovernmental relations, management style, and public participation are discussed.

Pub. Jul. 72: 231p., NTIS No. PB-212 717; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0244, ATLANTA METROPOLITAN AREA URBAN FLOOD RUNOFF CHARACTERISTICS - GEORGIA

H.G. GOLDEN, U.S. Dept. of the Interior, Geological Survey, Atlanta, Georgia 30309

Urbanization produces vast changes in the flood runoff characteristics of streams; therefore, natural (rural) basin flood-frequency relations are not applicable to urban streams. Few hydrologic data observations currently are available for streams in metropolitan areas. Flood-frequency data are needed in the design of drainage structures and in the regulation of developments in the flood plain. Water quality and sediment data for urban streams are needed for the design of pollution control facilities and for planning of low environmental impact developments.

To provide a method for estimating the magnitude and frequency of floods for streams in the Atlanta, Georgia, metropolitan area. Also, to collect information on floods as they occur on streams in the area to provide stages at specific locations and to locate chronic or potential flood problems. To provide water quality and sediment data for utilization in minimizing construction pollution, proper design of pollution control facilities, and control and regulation of polluters.

About 30 urban basins in the Atlanta metropolitan area will be selected to represent a range in drainage area (1 to 15 sq mi), imperviousness, storm sewers samples of urban, suburban and industrial developments, as well as a range of topographic variables. When sufficient data (about 30 significant runoff events) are available at a site, USGS rainfall-runoff model will be calibrated and used to synthesize flood peak data. When sufficient peak data, representing varying degrees of urbanization, have been synthesized a regionalized urban flood-frequency relationship can be developed.

properties of culvert and channel of proposed sites. Approximate drainage areas, channel slopes, and types of land use have been determined to assure an adequate range of these parameters when selecting gage sites. (Text Abridged)

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0245, WATER RESOURCES OF MIDDLE GEORGIA

UNKNOWN, Middle Georgia Area Plan. Com., Macon, Georgia

Abstract: The report includes: an inventory and analysis of the area's water resources; estimates of future requirements for beneficial use; guidelines for the preparation of master plans for storm drainage and flood control by local governments; and a program for flood plain management. A glossary of terms and bibliography of reference materials used in preparation of the report is provided.

Pub. Mar. 72: 261p., NTIS No. PB-211 286; PC \$15.25 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0246, SPACE-TIME VARIATIONS IN HIGH INTENSITY RAINFALL ON THE WINDWARD COAST OF THE ISLAND OF HAWAII (PHASE III)

C.M. FULLERTON, Univ. of Hawaii, Cloud Physics Observatory, Hilo, Hawaii 96720

The basic questions being addressed are as follows: a. How long do particular shower cells of varying intensities last, and how much total rain do they produce? b. How does the rain vary in space and in time? c. How are the movements of smaller scale features within the shower related to the movement of the shower as a whole? d. How might the results to be obtained related to infiltration and runoff, lead to criteria for water catchment locations and flood predictions?

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Res.

6.0247, HYDROLOGIC RELATIONS IN HAWAII

D. JAY, U.S. Army, Pacific Ocean Division, Honolulu, Hawaii 96813

Purpose of study/investigation: To obtain data on rainfall-runoff relations in Hawaii for establishing criteria for hydrologic design of flood-control projects and for flood-plain information studies.

Approach or plan: The investigation involves collection of rainfall and streamflow data. The basic data are analyzed to derive general rainfall-runoff relations which are incorporated into hydrologic design criteria.

Progress to date: Project Bulletin No. 1, printed 30 November 1964, shows the preliminary results of studies in the Kulihi Basin. Collection of rainfall and streamflow data has been completed. Correlation of physical characteristics of the drainage areas to their effects on runoff, and development of unit hydrographs have not been completed. Funds have not been available since FY 69 to complete this study due to budgetary limitations.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0248, FLOOD INUNDATION STUDY - WISCONSIN

R.S. GRANT, U.S. Dept. of the Interior, Geological Survey, Honolulu, Hawaii 96814

MAJOR DISASTER TYPES

The primary objective of this project is to determine inundation limits for flood discharges of sufficient magnitude so that state and local governmental agencies may formulate meaningful zoning ordinances.

Flood inundation studies will be conducted for specific areas as designated by the cooperating agency. The priority of areas is to be determined by potential and/or existing flood hazard and the availability of topographic and hydrologic data. Actual field surveys will be made to establish a sufficient number of channel characteristics to enable computations of water surface profiles. The inundation limits will be presented on a series of enlarged areal photographs. A brief text will be included.

Step-backwater analyses agreed well with historic flood data available.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0249, SPECIAL FLOOD DATA COLLECTION, HAWAII
R. LEE, U.S. Dept. of the Interior, Geological Survey, Honolulu, Hawaii 96814

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with the State of Hawaii.

Purpose: To collect flood information at a wide variety of sites that will be useful in the design and location of structures on or near streams and allow definition of the magnitude and frequency of floods on a regional basis.

Methods: Ninety-two crest-stage gaging stations are being operated to supplement peak-discharge records from the regular stream-gaging network. The records of peaks will be analyzed by multiple regression methods to determine regional flood frequency and magnitude relations.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0250, FLOOD PLAIN MAPPING IN HAWAII
R.H. NAKAHARA, U.S. Dept. of the Interior, Geological Survey, Honolulu, Hawaii 96814

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with the State of Hawaii.

Purpose: To delineate flood inundation areas throughout the State and thus aid responsible agencies in the development of flood plain zoning.

Methods: Records of peak discharges from the gaging station network will be used to determine the magnitude and frequency of floods. Field surveys of inundated areas will be made and transferred to enlarged topographic maps (scale 1:12,000) to delineate the inundated areas. Historical data and information from local residents will be compiled.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0251, SPECIAL FLOOD DATA COLLECTION - HAWAII UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Honolulu, Hawaii 96814

The rapid growth in population in Hawaii has resulted in increasing urbanization. Progressive encroachment on flood plains has caused many zoning and engineering problems.

The objective of this project is to collect flood information at a wide variety of sites that will be useful in the design and location of structures on or near streams. In the final stage, the

Annual flood report completed. Preliminary network made. Efforts made to improve quality of data.

Continue network operation, changes to be made in work evaluation. Update frequency curves and relation relations. Incorporate regression relations in flood report.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0252, HAWAII ENVIRONMENTAL SIMULATION MODEL

D.C. COX, Univ. of Hawaii, School of Arts, Honolulu, Hawaii 96822

The major objectives of the Hawaii Environmental Simulation Laboratory for the project period are: to develop and simulate the environmental effects of alternative decisions with respect to the interrelated aspects of land use, public facilities, flooding, and water quality for the Kaneohe region of Oahu; to develop means interactively with State and county agencies to use them with representatives of these agencies and special interest groups in the simulation of future environmental consequences based on various possible alternative decisions. The results of these simulations will be presented to official planning bodies. HESL will also provide assistance to the development of means for simulation with respect to water pollution and the ecology of Kaneohe Bay.

SUPPORTED BY U.S. Natl. Science Foundation

6.0253, NATURAL DISASTER ANALYSIS FOR LAMUI COUNTY, IDAHO, JUNE 1973

H.W. LEE, State Planning & Com. Aff. Agency, Boise, Idaho 83720

This report includes an analysis of the natural disasters to each community within Lamui County. Included in the analysis are such items as natural disasters which have occurred, the communities' ability to meet and cope with natural disasters, possible threats, and sections of the communities most susceptible to each type of natural disaster.

A roster of the organizational structure of each community is included along with a listing of contact persons for each community. These listings will become part of the disaster mitigation process.

Several flood plain delineation maps are included which were developed by the Corps of Engineers. These maps show approximate limits of the 100-year flood for the major rivers along which the major flood damage occurs in Lamui County.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0254, MAGNITUDE AND FREQUENCY OF FLOODS IN SMALL DRAINAGE BASINS IN IDAHO

C.A. THOMAS, U.S. Dept. of the Interior, Geological Survey, Boise, Idaho 83702

Abstract: A method which relates basin characteristics to peak flow characteristics is presented for determining the magnitude and frequency of floods on streams with drainage areas between 0.5 and 200 square miles. Regression equations for each of eight regions are presented for determining peak flow characteristics.

Pub. Apr. 73; 97p., NTIS No. PB-222 409/5; PC \$7.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0255, DEPTH AND FREQUENCY OF FLOODS IN ILLINOIS

J.D. CAMP, U.S. Dept. of the Interior, Geological Survey, Champaign, Illinois 61820

Fairly reliable procedures have been developed for estimating the magnitude of peak discharges corresponding to various frequencies of flow for streams throughout Illinois. Techniques also are available that permit reasonably accurate determinations of depths for given magnitudes of discharge in a stream channel. Those techniques, based on hydraulic principles, require field surveys to determine channel characteristics and, in general, they must be applied by someone trained and experienced in hydraulics. Often the uses for which flood-depth information is needed do not justify the precision nor the effort required to apply those techniques. For example, the nationwide project to delineate flood-prone areas (House Document 465) would be facilitated if a simple procedure were available for making, rather quickly, estimates of flood depths along ungaged streams.

To develop techniques and procedures that can be used for estimating depth-frequency relationships for streams throughout Illinois. Those techniques and procedures are to be simplified so that they will be useful to people with non-technical backgrounds, such as local planners, real-estate appraisers, etc.

The recently completed report on magnitude and frequency of flood discharges for Illinois streams will be used with stream-flow records for approximately 300 sites in the State to define flood discharges for selected frequencies ranging from the 2- to the 100-year recurrence interval. Stage-discharge relationships available for those sites will be used to determine corresponding depths of flow. Depths of flows for various frequencies will be correlated, by multiple-regression techniques, with stream channel and basin characteristics as independent parameters, to define regional equations that relate depths to parameters that can be measured or estimated from maps.

Initiated manual compilation of data and correlated depths of flows for various frequencies by multiple-regression techniques.

Continue analyses and define regional equations, prepare open-file report, and distribute same to interested parties.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0256, FLOOD FREQUENCY STUDY ILLINOIS

J.M. CARNS, U.S. Dept. of the Interior, Geological Survey, Champaign, Illinois 61820

The magnitude and probable frequency of recurrence of floods are primary factors in the design of structures within the flood plains of streams in the entire state of Illinois. A report entitled 'Floods in Illinois: Magnitude and Frequency' (Mitchell, 1954) was based on flood records through 1950.

An update of the station data of the 1954 report will

A study will be made to identify and correlate the data that best describe the flood-producing characteristics of streams. Techniques will show how floods of various recurrence intervals, on basis of the independent parameters of drainage area, basic lag time, and geographic location, can be estimated for any location. The present analysis includes records collected after 1954 on many streams. 10 sq. mi. Additional parameters will improve the accuracy of estimates of floods at ungaged sites.

Report published by cooperator December 1973. Ready for printer on June 30, 1972; publication withheld until printing funds were released by state of Illinois. Distribution of the report was made in January 1974.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0257, COMMUNITY GOALS - MANAGEMENT OF FLOOD RISK - AN APPROACH TO FLOOD RISK MANAGEMENT

J.R. SHEAFFER, Univ. of Chicago, Center for Urban Planning, Chicago, Illinois 60637

Abstract: The publication presents a methodology for evaluating first-round local effects related to the availability of water for supply purposes or recreation. It develops estimates of demand for reservoir recreation, estimates the change in structural unemployment from changes in output. It evaluates the difference between regional multiplier values and proposes a refinement of multiplier estimates; it integrates the various research findings and presents a case for a selected strategy for those national income benefits to water resource management in excess of direct output valued in terms of willingness to pay.

Pub. May 70; 257p., NTIS No. AD-707 461; HC \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0258, NATURAL CAPABILITIES - THE CREEK SERIES, MACON COUNTY, ILLINOIS - UNKNOWN, Macon Co. Regional Plan Comm., Illinois

Abstract: The study analyses the natural capabilities of Creek Township in terms of suitability for agriculture, urban development, countryside development, tie tank systems. It considers relationships of geological structures, ground water availability, characteristics, stream pollution and potential development for human and natural needs. The summary map showing suitability of overall land uses and types of development.

Pub. Jan. 70; 95p., NTIS No. PB-194 677; HC \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0259, RESEARCH INITIATION - A MULTIVARIATE STOCHASTIC MODEL FOR FLOODING

model. Goodness-of-fit tests, such as the chi-square and Kolmogorov-Smirnov, will be used to quantitatively evaluate the appropriateness of fitted models. Rainfall processes will be combined with various rainfall-runoff models in order to study the effect of selected geographical and man-made features on dangerous runoff levels. It will be the intent to study levels that are harmful in their long term ecological effects on the environment as well as those levels producing immediate damage. The floods themselves (although not the individual storms) will be well modeled as occurring in a Poisson or Markov manner. Included will be the gathering of data on flood damage in an effort to provide a realistic cost function.

SUPPORTED BY U.S. Natl. Science Foundation

6.0260, A COMPREHENSIVE PLAN FOR STEPHENSON COUNTY, ILLINOIS

UNKNOWN, Stephenson Co. Planning Comm., Freeport, Illinois 61032

Abstract: The Stephenson County Comprehensive Plan is an integration of the plans of the local communities based upon the broad framework of a plan for the entire county including environmental factors, land utilization, highways, drainage, community facilities, recreation, and housing. Based upon an analysis of the data, the comprehensive plan includes recommendations for land use, thoroughfares, community facilities, public buildings and public utilities. The plan lists the following opportunities for development in Stephenson County: redevelopment of Freeport, the central city; community and neighborhood improvement; development of Highland Junior College; industrial development; boating and recreation of the Pecatonica River; expansion of Lake J. A. Aqua-Nu State Park; development and relocation of U.S. Route 20; development of a major park on the Rock Run Creek; and development of vacation housing.

Pub. Jul. 70: 341p., NTIS No. PB-193 922: IIC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0261, FLOOD INUNDATION MAPPING, NORTHEASTERN ILLINOIS

A.W. NOEHRE, U.S. Dept. of the Interior, Geological Survey, Oak Park, Illinois 60303

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with the State of Illinois and the Northeastern Illinois Planning Commission.

Purpose: To prepare inundation maps for the Northeastern Illinois Metropolitan area, covering sixty-two 7 1/2-minute quadrangles.

Methods: Records will be obtained from an extensive crest-stage gage network, of which 69 sites will be rated for discharge in the 19 quadrangles remaining to be mapped. These records and previously established data collection points will be used to define flood profiles, inundation boundaries, and flood-frequency relationships. Inundation maps will be superimposed on topographic quadrangles and published as Hydrologic Atlases.

SUPPORTED BY U.S. Dept. of Interior, Geological Survey,

resource activities involving State programs or developmental responsibilities. State guidelines for administrative evaluation and for expediting specific proposals are defined. These administrative tools are designed to speed accurate evaluation and processing of both State and Federal development activities. Coordinated guidelines and a system of priorities are presented to facilitate the administration of Federal or State financial assistance to local communities for each of the water resource related programs.

Pub. May 70: 215p., NTIS No. PB-198 105: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0263, STREAMFLOW VARIABILITY - ILLINOIS

K.P. SINGH, State Water Survey, Urbana, Illinois 61801

Basic research into the inherent variability of streamflow is being pursued. Understanding the variability of streamflow provides fundamental knowledge which will be useful in processing Illinois streamflow to provide answers to many questions in areas of water supply direct from streams, drainage duration of low flows and high flows, zoning of flood plain land, and floods.

Investigation of baseflow recessions, recharge, stream entrenchment, evapotranspiration, etc., have improved the understanding of low flow variability. Streamflow variability over the entire range of flows has been analyzed in terms of flow duration of 120 streams in Illinois. It shows the importance of physiography in delineating hydrologically similar divisions and the effect of basin size on flow variability within a given division. A versatile transform has been developed for statistically analyzing monthly runoffs. Research is being extended for seasonal low flows and daily-flow variability parameters for a month.

SUPPORTED BY Illinois State Government - Springfield

6.0264, EVALUATION OF FLOOD RISKS

K.T. CHOW, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

Flood data at ten stream gaging stations on rivers in Illinois are analyzed for their characteristics of flood generation on the basis of the theory of nonparametric probability distributions. Once the probability model for flood occurrences is formulated, flood sequences are generated by the Monte Carlo method and then compared with historical flood sequences.

SUPPORTED BY University of Illinois

6.0265, RUNOFF FROM SMALL AGRICULTURAL AREAS IN ILLINOIS

B.A. JONES, Univ. of Illinois, Agricultural Experiment Sta., Urbana, Illinois 61801 (ILLU-10-0312)

Objective: Determine the frequencies of peak rates and volumes of runoff from agricultural watersheds of 25 to 1000 acres located on permeable soils with mild slopes in Central Illinois. Test and evaluate the usefulness of mathematical hydrologic models to small agricultural watersheds with mild topography. Provide benchmark watersheds in Central Illinois for the study of the quality of runoff water.

6.0266.

Progress All of the rainfall and all but one station of runoff data from the Allertown watersheds for 1971 have been reduced, tabulated and assembled for analysis. The 1971 wind and past temperature - humidity data are continuing to be manually transcribed as time permits. Although the 1972 rainfall-runoff data has not been fully tabulated, this year's data provides much needed periods of above normal rainfall. August rainfall was nearly twice the normal for the area and included two large volume rainfall periods. September rainfall was more than twice the normal and included five large rainfall periods. Three of these rainfall periods were in an eight-day period. A major effort was devoted to the replacement of the 30-year old instruments which were deteriorating rapidly. Four recording rain gages and one hygrothermograph were replaced with similar new equipment. The anemometer was also replaced with an event recorder added so that continuous wind speed records may now be obtained. Previously only total wind distance was recorded at each recording period, usually one week.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

6.0266. AN APPRAISAL OF FLOODPLAIN REGULATIONS IN THE STATES OF ILLINOIS, INDIANA, IOWA, MISSOURI AND OHIO

H.M. KEITH, Univ. of Illinois, Water Resources Center, Urbana, Illinois 61801

Abstract The objectives were to determine why state statutes and local zoning ordinances are not effectively used in floodplain management, to determine alternative methods available and to analyze the alternatives to determine their suitability for management purposes. The objectives were only partly achieved within the time frame of the study. A repository of enabling legislation, information and inventory reports and ordinances relating to floodplains has been established for Illinois, Indiana, Iowa, Missouri and Ohio. This can be used for monitoring and evaluating changes in regulations and management procedures. An analysis of the floodplain regulations in these five states is presented.

Pub. Apr. 73: 29p., NTIS No. PB-219 234/2: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0267. HYDROLOGIC MODELS OF THE GREAT LAKES

D.D. MEREDITH, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

The objective of the proposed research is to develop deterministic and stochastic hydrologic models of the Great Lakes in order to better understand the Great Lakes as a system and to provide information for planning and management of the Great Lakes water resources. This objective is to be satisfied by (1) developing a deterministic simulation model on a monthly basis in order to reproduce the historical level of the Great Lakes using the components of the hydrologic cycle; namely, precipitation, evaporation, surface runoff and ground water flow; (2) performing a sensitivity analysis to determine the effects of changes in these components on the Great Lakes level; (3) developing stochastic models for each of the individual components of the hydrologic system; (4) combining these individual models in order to study the stochastic behavior of the Great Lakes system.

UNKNOWN, Clyde E. Williams & Assoc. Inc., Indianapolis, Indiana

Abstract: Standards and maps are presented for zoning an unincorporated area of Knox County, Indiana.

Pub. Dec. 71: 150p., NTIS No. PB-206 088: PC \$5.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0269. HYDRAULICS OF SHALLOW FLOW OVER STABLE ERODED SAND SURFACES DEFINING A SPECTRA

J.R. BURNEY, Purdue University, Water Resources Center, Lafayette, Indiana 47907

Abstract: Estimation of the hydraulic response of a land to shallow overland flow is of major concern in the flood control and dependent structures in small agricultural watersheds. The problem concerns the necessity for the appropriate depth-discharge relationship, based on observation of the physical land surface form. The developments, tests and evaluates instrumentation for the physical configuration of a natural, shallow land surface include both grain and form effects, and attempts to provide the information to the hydraulic response of the surface.

Pub. Feb. 73: 141p., NTIS No. PB-221 347/8: PC \$5.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0270. THE EFFECT OF URBANIZATION ON THE HYDROLOGY OF WATERSHEDS IN INDIANA

J.B. DELLEUR, Purdue University, School of Engineering, Lafayette, Indiana 47907

One of the main objectives of the research is to develop mathematical models which would characterize the effect of urbanization on runoff. To achieve this purpose, data from watersheds of varying degrees of urbanization in Lafayette, Indiana, as well as from other watersheds in Indiana and elsewhere will be used. Presently being collected from two watersheds in West Lafayette, Indiana, the Ross Ade Drain Watershed (362 acres) and the Purdue Swine Farm Watershed (470 acres). Each watershed is subdivided into an upper and a lower watershed and runoff are also collected for upper watershed. Data collection from these watersheds will continue as part of the proposed study.

Data analysis will be carried out by means of conceptual mathematical models simulating watersheds of varying degrees of urbanization. Linear and nonlinear mathematical models will be used to investigate the effect of urbanization on runoff. After suitable models are selected, it is intended to develop a design manual based on the results of the study for the use of practicing engineers.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0271. WABASH RIVER SYSTEMS MODELS FOR FLOOD MANAGEMENT, PLANNING AND EVALUATION

G.H. TOEBES, Purdue University, School of Civil Engineering, Lafayette, Indiana 47907

The research encompasses the use of mathematical models

information to potential users. Indicated will be how to extend the simulation model to encompass the entire Wabash River for the purpose of day to day water resource management in the Wabash Basin.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Res.

6.0272, ECONOMIC FACTORS AFFECTING CHANGE IN THE INTENSITY OF FLOOD PLAIN USE

J.R. BARNARD, Iowa State University, Water Resources Research Inst., Ames, Iowa 50010

Abstract: The extent of agricultural land use change on the floodplain of the Iowa River as a result of the building of the Coralville Dam is examined. The dollar values of benefits from land use change are estimated and compared to the original project study estimates prepared by the Corps of Engineers. The study also analyzes the factors affecting land use change.

Pub. Dec. 71: 13p., NTIS No. PB-208 610; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0273, THE HUMAN ECOLOGICAL IMPACT OF STRUCTURAL FLOOD CONTROL ON THE IOWA RIVER, IOWA

J.S. GARDNER, Iowa State University, Water Resources Research Inst., Ames, Iowa 50010

Abstract: Human ecological impacts of the Coralville Dam and Reservoir, a flood control structure on the Iowa River, Iowa are described. Impacts include agricultural and urban land use changes, recreation participation growth, changes in stream hydrology, erosion, debris and problems associated with prolonged, controlled outflows from the dam and high water levels in the reservoir, and a number of indirect effects of these changes. Prolonged and high outflows from the dam have produced downstream flooding on agricultural land. Resulting conflicts between farmers and the Corps of Engineers over the flood control structure and its operation have lessened its beneficial image at the local level. The research indicates careful attention should be directed to scale of impact, dynamics of impact, zone or location of impact, socio-economic distribution of impact and components of impact, in environmental and human ecological analyses.

Pub. Dec. 73: 270p., NTIS No. PB-228 644/1; PC \$16.50 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0274, FLOOD PROFILES OF IOWA STREAMS

O.G. LARA, U.S. Dept. of the Interior, Geological Survey, Iowa City, Iowa 52240

Information is needed on flood peaks and profiles for the economic and safe location and design of bridges and other structures on or over streams and their flood plains. Defining the limits of flood inundation and establishing encroachment limits on flood plains are companion problems needing the same kind of information.

To define the profiles of at least one major flood of record and of floods of selected frequency--usually the 25- and 50-year floods--along streams draining 100 or more square miles.

High-water marks are set along the streams after major floods and later tied to MSL datum. Gaging station records and supplemental discharge measurements are used to define peak discharges along the streams. Stage-discharge relations at strategic points are defined by step-backwater computations.

set and tied to mean datum for outstanding need of September 1972 in Nishnabotna R. basin. Field data on moderate flood in Floyd River basin was obtained. Record flood of April 1973 in lower Skunk R. basin was profiled and infrared and multi-spectral aerial photography obtained. Leveling work continued in Skunk R. basin. Work was done on updating and revising Rock River profile report.

Complete profile work in lower Skunk R. basin for inclusion in Mississippi River flood report. Continue leveling work in rest of Skunk basin and begin level work to tie high-water marks to sea level datum in Nishnabotna River basin. Publish updated Rock River report.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0275, FLOOD PROFILES & FLOOD-PLAIN INFORMATION, LINN COUNTY, IOWA

O.G. LARA, U.S. Dept. of the Interior, Geological Survey, Iowa City, Iowa 52240

Spillover of development from the Cedar Rapids-Marion Metropolitan area into the county posed potential problems in flood-prone areas along small streams in Linn County.

To provide flood information useful to regulatory agencies in guiding development of flood-prone lands. A supplementary objective is to provide data useful for planning and design of new highways and bridges and rehabilitation of existing inadequate facilities.

High-water marks are set after occurrence of significant floods and are tied to MSL datum by levels. These data together with valley cross-sections and step-backwater computations are used to produce flood profiles and definition of inundated areas. Site studies are made at the request of the cooperator.

Completed surveying and leveling work for Big Creek.

Prepare special reports on selected bridge-sites as requested by the cooperator. Prepare on Big Creek, if actual flood-profile data is collected.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0276, FLOOD PROFILES & FLOOD-PLAIN INFORMATION, CEDAR RAPIDS, IOWA

O.G. LARA, U.S. Dept. of the Interior, Geological Survey, Iowa City, Iowa 52240

Expanding urban growth posed potential for problems relating to encroachment on flood plains of small streams in, and near the city of Cedar Rapids.

Obtain flood information on small streams in and near the city to aid State and local agencies in flood-plain management.

Obtain information on the discharge and profiles of significant floods that occur. Using standard methods of step-backwater computation, prepare profiles for floods of selected frequency and for predetermined degrees of flood-plain encroachment. Studies to be pursued each year are determined in conference with cooperator.

Continued operation of gage on Vinton Ditch. Obtain section properties for use in computer program analyzing effect of on-channel reservoirs on flood flows. Computer program results relayed to city through conference with city engineering staff.

Continue Vinton Ditch record collection and study. Assemble and analyze all flood information on Vinton Ditch for final report to city.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

O.G. LARA, U.S. Dept. of the Interior, Geological Survey, Iowa City, Iowa 52240

Data concerning flood peaks and flood profiles are needed to answer fundamental questions on flood-plain management, and development of city flood-plain zoning ordinance.

To supply floodway information and define the profiles of floods of selected frequency

Using standard methods of step-backwater computation, prepare profiles for floods of selected frequency and predetermined degrees of flood-plain encroachment.

Work completed and report prepared on flood-flow study defining flood profiles and inundation limits along University Branch, Dry Run Creek, in city of Cedar Falls.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0278, FLOOD FREQUENCY, LOG-PEARSON TYPE III ANALYSIS - IOWA

O.G. LARA, U.S. Dept. of the Interior, Geological Survey, Iowa City, Iowa 52240

Action and regulatory agencies, such as the Iowa natural resources council, are confronted with problems arising from inconsistencies in flood-frequency results reported by various agencies. The water resources council (1967) has recommended the Log-Pearson Type III method for general use and, in line with this recommendation, the cooperator wished to have a re-analysis of all Iowa flood records using the recommended method.

A primary objective was to up-date all Iowa flood records, analyze them using the Log-Pearson type III method as a base, and prepare a user manual for application of the method developed. A secondary objective was to carry on concurrent analyses of flood data using the index-flood and log-normal methods and to compare the results obtained by the various methods.

All station data for Iowa streams will be analyzed using the Log-Pearson III method. Regional relationships will be developed using correlation with physical and climatic parameters. Upon completion of this phase a user manual will be prepared for the practitioner. A second report, a technical report, which will contain comparative data on the methods studied and technical discussion on sampling procedures, errors, correlations, etc. Both reports to be published by cooperator.

A user manual on computing magnitude-frequency relations for Iowa streams was revised as suggested in colleague review and is now being printed through auspices of cooperator. A technical report on flood-frequency studies in Iowa was essentially completed and will be ready for colleague review in a few weeks.

Technical report to be published by cooperator following colleague review. Project will be completed then.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0279, FLOOD PROFILES AND FLOOD-PLAIN INFORMATION, CEDAR RAPIDS, IOWA

H.H. SCHWOB, U.S. Dept. of the Interior, Geological Survey, Iowa City, Iowa 52240

This research is part of the program of water resources investigations conducted by the U.S. Geological Survey in cooperation with state and local agencies in Iowa.

Methods: Flood-profile data will be obtained in the near future immediately after the occurrence of significant floods or by computation using channel cross sections and other pertinent field data.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0280, FLOOD PROFILES AND FLOOD-PLAIN INFORMATION, LINN COUNTY, IOWA

H.H. SCHWOB, U.S. Dept. of the Interior, Geological Survey, Iowa City, Iowa 52240

This research is part of the program of water resources investigations conducted by the U.S. Geological Survey in cooperation with state and local agencies in Iowa.

Purpose: To define flood profiles and obtain flood information on several small streams in Linn County that will be useful to local agencies in future development and in formulating and administering zoning regulations.

Methods: Profiles of flood flow and low flow will be obtained and discharge measurements made at a sufficient number of points along the selected streams to define the stage-discharge relations. Flood-frequency data will be computed.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0281, EFFECT OF URBANIZATION ON FLOOD RUNOFF - WICHITA AREA, KANSAS

C.O. GEIGER, U.S. Dept. of the Interior, Geological Survey, Lawrence, Kansas 66044

This research is part of the program of water resources investigations conducted by the U.S. Geological Survey in cooperation with State and local agencies in Kansas.

Purpose: To investigate the relation of changes in land use in urban areas to corresponding changes in high-water discharge characteristics.

Methods: Flood-volume runoff is being defined in seven small basins where degree of urbanization varies from rural and likely to remain rural, through degrees of expanding urbanized areas to completely urbanized. Rainfall at 5 to 15 minute intervals are defined at 6 sites and daily rainfall at about 43 sites. Degree of urbanization is defined in each basin at 3-year intervals.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0282, EFFECT OF URBANIZATION ON FLOOD RUNOFF - WICHITA AREA

D.B. RICHARDS, U.S. Dept. of the Interior, Geological Survey, Lawrence, Kansas 66044

Little is known about the effect of urbanization on the flood discharge in Kansas.

To determine the effect of urbanization on flood discharge in Wichita.

Basins in Wichita, for which the percent of impervious area and area served by storm sewers can be determined, have been instrumented to measure the variables of rainfall and runoff. The change in the shape of unit hydrographs will be used to monitor the effect of increased urbanization. A generalized digital watershed model will be developed.

Started modeling data from three rainfall-runoff recorders in small urbanized basins in East Wichita. Continued to collect sediment samples at one site in a partially urbanized basin currently undergoing construction. Continued to measure moisture conditions in the basins by means of neutron logging.

Continue to operate the gaging stations and analyze the data.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0283, ZONING ORDINANCE AND ORDER, PIKE COUNTY, ELKHORN CITY, KENTUCKY

UNKNOWN, State Program Dev. Office, *Frankfort, Kentucky* 40601

Abstract: The purpose of this County Zoning Order and City Ordinance is to promote the public health, safety, morals and general welfare by providing for a reasonable, logical and desirable comprehensive system or pattern of land use in the unincorporated area of the county, by preventing the mixing of incompatible land uses, by lessening street congestion, by avoiding undue concentration of population, by preventing erosion of land, by securing safety from fires, floods, and other dangers, by providing adequate light and air, by facilitating the provision of public and private utilities, and, where applicable, by implementing the Land Use Plan and other elements of the county's Comprehensive Plan for future development.

Pub. Dec. 69: 93p., NTIS No. PB-192 700: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0284, ZONING ORDINANCE - PAINTSVILLE, KENTUCKY

UNKNOWN, State Program Dev. Office, *Frankfort, Kentucky* 40601

Abstract: The revision of the ordinance contains regulations for the control of mobile homes, flood plain zoning and townhouses. These regulations were extracted from information obtained from the Department of Health, Education and Welfare.

Pub. Jan. 71: 60p., NTIS No. PB-201 544: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0285, OPSET - PROGRAM FOR COMPUTERIZED SELECTION OF WATERSHED PARAMETER VALUES FOR THE STANFORD WATERSHED MODEL

E.Y. LIOW, Univ. of Kentucky, Water Resources Institute, *Lexington, Kentucky* 40506

Abstract: The Stanford Watershed Model uses a hydrologic budget to model the land phase of the hydrologic cycle and thereby simulate streamflow on a continuous basis from climatological data and watershed parameters. Values for key parameters are estimated by trial-and-error. Subjective estimating differences have made it difficult to correlate parameter values with known physical characteristics of the watershed. This study sought to computerize a parameter optimization procedure based on the FORTRAN version of the Stanford Watershed Model known as the Kentucky Watershed Model. The resultant self-calibrating watershed model is named OPSET because it determines an optimum set of parameter values by matching synthesized flows with recorded flows. The first step in program development used sensitivity studies to determine which watershed parameter values are critical in simulating flow and are difficult to measure directly. The second step was to adjust estimates of the

basis, and values best describing watershed characteristics should be averaged from several OPSET-selected one-year-based values.

Pub. 1970: 313p., NTIS No. PB-198 442: PC \$6.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0286, FLOOD PLAN FOR BULLITT COUNTY, KENTUCKY

A. HATHBY, Bullitt Co. Planning Comm., *Shepherdsville, Kentucky* 40165

The purpose of this Flood Plan is to provide basic data on flooding in Bullitt County as a background for information and recommendations on floodplain development control measures in light of and relevant to the appropriateness of the National Flood Insurance Program.

The report begins with a description of flood-plains including their land use, and the history of flooding and flood damages. Existing public and semi-public measures to deal with and compensate for flood hazards are then discussed. Based on a description of the National Flood Insurance Program including its benefits and eligibility requirements and the generally recommended development regulations for floodplains, the alternatives available to Bullitt County are outlined.

Pub. May 73: NTIS or Bullitt County Planning Commission.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0287, SMALL STREAMS FLOOD FREQUENCY IN MAINE

G.S. HAYES, State Highway Commission, *Augusta, Maine* 04330

Abstract: The preliminary report is of the progress made to date on the small (1 to 50 square miles) watershed study in Maine. The findings of the report are limited by short (6 years) runoff records used to derive a formula for peaks of up to the 10-year frequency. The formula uses the following basin characteristics: drainage area, channel slope, channel length, storage, forest cover. The formula is an adaptation of an earlier USGS method which was limited to large watersheds.

Pub. Mar. 71: 11p., NTIS No. DB-204 371: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0288, DATA AND MANAGEMENT NEEDS FOR WATER RELATED LAND AREAS - MAINE

E. KEENE, North Kennebec Reg. Pln. Comm., *Waterville, Maine* 04901

This project will investigate the data needs necessary to enable rational decision-making with respect to flood plain zoning and proper utilization of riparian lands along the main stem of the Kennebec River in Maine. Recommendations will be made for involving local governments in the decision making and incorporate long term planning for community development as well as non-structural alternatives such as local zoning and the new State level zoning authority.

Certain kinds of data are available, but no comprehensive analysis of availability and need has ever been done. The regional

6 0289.

to measure proposals; and (4) drafting of a proposed management scheme

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0289. CLIMATES OF THE STATES - CLIMATE OF NEW YORK

A.B. PACK, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Silver Spring, Maryland 20910

Abstract: The data summary on the climate of New York presents a brief physical description of the state and brief descriptions of its general climatic features, its temperature, precipitation, snowfall, floods, winds and storms, as well as other climatic elements and their relationship to the economy.

Pub. Jun 72. 31p., NTIS No. COM-72-50990; PC-GPO MF \$0.95

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0290. PROBABLE MAXIMUM PRECIPITATION AND SNOWMELT CRITERIA FOR RED RIVER OF THE NORTH ABOVE PEMBINA AND SOUTHERN RIVER ABOVE MINOT, NORTH DAKOTA

J.T. RIEDEL, U.S. Dept. of Commerce, National Weather Service, Silver Spring, Maryland 20910

Abstract: The purpose of this study was to provide estimates of probable maximum precipitation (PMP) and other meteorological criteria needed for determining the combined snowmelt and rain flood for 11 subbasins of the Red River of the North above Pembina, North Dakota and two subbasins of the Souris River above Minot, North Dakota. General estimates of PMP were prepared. From the charts and graphs presented, estimates of PMP may be determined for any selected subbasin in the two river drainages. In the second chapter meteorological summaries are given of the major weather features of the storms most important to setting the level of PMP. Subsequent chapters deal with all-season probable maximum precipitation, seasonal and geographic variations, time and areal distribution, snowmelt criteria, snowpack available for spring melt. Finally a stepwise procedure is given for obtaining PMP and the snowmelt criteria for any subbasin.

Pub. May 73. 81p., NTIS No. COM-73-5069616; PC-GPO MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0291. ECONOMIC AND LEGAL ANALYSIS OF ALTERNATIVE FLOOD CONTROL STRATEGIES

J.H. FOSTER, Univ. of Massachusetts, School of Agriculture, Amherst, Massachusetts 01002

Current analysis on which flood control decisions are based is deficient in both economic and legal content. Objectives of this project are: Studies of five different flood control alternatives will include a state of knowledge report, collection of relevant Connecticut River Basin data, legal considerations, and equity impact. Emphasis will be given to intangible costs and benefits. A final step will be to determine an optimum strategy by use of the JAMES computer program with modifications for intangibles

In addition, the legal sub-project will identify legal implications

6.0292. DETERMINATION OF DECISION PROCESSES IN WATER RESOURCE PLANNING DEVELOPMENT - THE CONNECTICUT RIVER BASIN

E.R. KAYNOR, Univ. of Massachusetts, School of Agriculture, Amherst, Massachusetts 01002 (C-4116)

The proposed research project will investigate water planning and development in the Connecticut River Basin. Focus of the project will be on actual procedures rather than on institutional arrangements, laws, authority, and that is, project findings will answer the question 'what decides' rather than 'what agency has authority to decide'. Preliminary research indicates that the answers to these questions differ extensively. Research will be directed at actual action taken and at patterns of influence, rather than the formal system as it was designed to work.

Research will center on five water resource areas of the Basin: Water supply, waste water management, flood control, electric power generation, and water and land-based recreational and environmental enhancement programs. These five areas will be described in terms of present planning and development, and patterns of decision making will be ascertained by a combination of extensive interviews and exhaustive analysis of the written record. The final project report in 1975 will provide a detailed data base for use in redesigning institutional arrangements and will provide new analytic probes for use elsewhere in water resource planning and development.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. R.

6.0293. LEGAL ISSUES ON ECONOMIC UTILIZATION OF THE CONNECTICUT RIVER FLOOD PLAINS

D. WILKES, Univ. of Massachusetts, Man & His Environment Inst., Amherst, Massachusetts 01002

Identifies legal issues with an impact on permissible flood plains along the Connecticut River and issues the influence calculations of public costs involved in flood management along the River.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. R.

6.0294. LEGAL FACTORS IN ECONOMETRIC ANALYSIS OF LOCAL FLOODPLAIN MANAGEMENT DEVICES IN THE CONNECTICUT RIVER BASIN

D. WILKES, Univ. of Massachusetts, Water Resources Research Ctr., Amherst, Massachusetts 01002

Abstract: Content covers: administrative and legal context; use of econometric models in floodplain management; and problems of reducing vulnerability of floodplains. Measures to show accuracy of the process used to collect data inputs, persuasiveness of sources, and implications for calculator and computer runs.

Pub. Sep. 73. 54p., NTIS No. PB-226 765/6; PC \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0295. RE-DRAFT OF SEEKONK ZONING BY-LAW, NOVEMBER 1969

J. BLACKWELL, State Dept. of Community Affairs, Boston, Massachusetts 02202

Abstract: Contains a draft of a zoning ordinance and a list of

Pub. Jun. 69. 50p., NTIS No. PB-194 552: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0296, FLOOD CHARACTERISTICS OF SMALL DRAINAGE BASINS IN VERMONT

C.G. JOHNSON, U.S. Dept. of the Interior, Geological Survey, Boston, Massachusetts 02203

To obtain an adequate measure of streamflow characteristics of small drainage areas, and to analyze the streamflow records for the particular needs of the highway engineer.

The development of a technique for estimating the magnitude and frequency of floods on small drainage areas in Vermont for the use of the highway engineer.

Installation and maintenance of 11 continuous-recording stream gages with recording rain gages plus about 40 crest-stage gages on drainage basins of less than 10 square miles, all located in carefully selected places so as to sample a wide range of physiographic variables. Probably using a multiple-regression analysis.

Discharge data has been collected at 11 continuous-recording streamflow stations plus recording rainfall records in addition to annual peaks at the 40 crest-stage gages. A status report has been prepared.

Continuation of data collection.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0297, FLOOD CHARACTERISTICS OF SMALL DRAINAGE BASINS IN RHODE ISLAND

C.G. JOHNSON, U.S. Dept. of the Interior, Geological Survey, Boston, Massachusetts 02203

To obtain an adequate measure of streamflow characteristics of small drainage areas, and to analyze the streamflow records for particular needs of the highway engineer

The development of a technique for estimating the magnitude and frequency of floods on small drainage areas in Rhode Island, for the use of the highway engineer.

Installation and maintenance of 5 continuous-recording stream gages with recording rain gages plus about 15 crest-stage gages on drainage basins of less than 10 square miles, all located in carefully selected places so as to sample a wide range of physiographic variables. Probably using a multiple-regression analysis.

Discharge data has been collected at 10 continuous-recording streamflow stations plus recording rainfall records in addition to annual peaks at the 42 crest-stage gages. A status report has been prepared.

Continuation of data collection.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0298, USE OF ERTS-1 DATA - SUMMARY REPORT OF WORK ON TEN TASKS

F.J. THOMSON, Environmental Res. Inst. Mich., Ann Arbor, Michigan 48107

Abstract: The author has identified the following significant results. Depth mappings for a portion of Lake Michigan and at the Little Bahama Bank test site have been verified by use of navigation charts and on-site visits. A thirteen category recognition map of Yellowstone Park has been prepared.

land mapping has been accomplished by slicing of single band and/or ratio processing of two bands for a single observation date. Both analog and digital processing have been used to map the Lake Ontario basin using ERTS-1 data. Operating characteristic curves were developed for the proportion estimation algorithm to determine its performance in the measurement of surface water area. The signal in band MSS-5 was related to sediment content of waters by modelling approach and by relating surface measurements of water to processed ERTS data. Radiance anomalies in ERTS-1 data could be associated with the presence of oil on water in San Francisco Bay, but the anomalies were of the same order as those caused by variations in sediment concentration and tidal flushing.

Pub. Jan. 74: 80p., NTIS No. E74-10301: PC \$6.00 MF \$1.45.

SUPPORTED BY U.S. Natl. Aeron. & Space Adm.

6.0299, PREDICTION OF THE MAGNITUDES AND FREQUENCIES OF FLOODS IN MICHIGAN

E.F. BRATER, Univ. of Michigan, School of Engineering, Ann Arbor, Michigan 48106

Abstract: The report is divided into two parts: Part I provides a description of the research and detailed information on the results and application; and Part II gives the practical design curves. All known methods of predicting floods from precipitation were investigated and the infiltration capacity-unit hydrograph procedure was selected of this study. Data of rainfall, snow melt, and flood runoff from 58 drainage basins varying in size from 0.02 to 734 square miles were analyzed. The infiltration values were derived from 16 drainage basins in Southernmost Michigan. The shape of the unit hydrograph was found to depend on the area of the drainage basin and the degree of urbanization which was represented by the population density.

Pub. Aug. 71: 56p., NTIS No. PB-214 286/7: PC \$3.00 MF \$0.95.

SUPPORTED BY No Formal Support Reported

6.0300, AN ECONOMIC ANALYSIS OF FLOOD DAMAGE REDUCTION ALTERNATIVES IN THE MINNESOTA RIVER BASIN

A.R. HOPEMAN, Univ. of Minnesota, Water Resources Research Ctr., Minneapolis, Minnesota 55414

Abstract: Incidence of flood costs analysis provides justification for the imposition of land-use restrictions in flood plains in Minnesota. The analysis indicates that governmental units were the ultimate bearers of nearly half the flood costs in the Minnesota River Basin in the 1965 and 1969 floods. Government units have a substantial, justifiable interest in keeping flood costs down. Flood damage potential will continue to rise over time unless land use controls are instituted. Moreover, government costs are likely to make up an even larger proportion of flood costs in the future, with the advent of Federal flood insurance and an expanded Federal role in the provision of disaster relief. Therefore, thorough and vigorous enforcement of the 1969 Flood Plain Management Act is recommended. In areas where neither evacuation nor structural protection is economically feasible, land-use restrictions alone will have to suffice to curtail flood losses. The beneficiaries of structural flood control works ought to be assessed for a fair share of the costs of such works. This policy is not so crucial for existing flood plain developments, but is important for new urban and developments.

6.0301. FLOOD FORECASTING IN THE UPPER MIDWEST - DATA ASSEMBLY AND PRELIMINARY ANALYSIS

A.F. PABST, Univ. of Minnesota, St. Anthony Falls Hydrol. Lab., Minneapolis, Minnesota 55414

Abstract: The objective of this study is the development of analytical procedures and the correlation of hydrologic data to aid in the prediction and control of spring floods in large Upper Midwest watersheds. The study is divided into three phases. The present work (Phase I) has involved (1) the assembly of meteorological and hydrological data concerning past spring floods and new data pertaining to floods during the contract period and (2) procurement and preliminary evaluation of selected mathematical models of watersheds. In future work under phases II and III the data will be subjected to further analysis using available mathematical models, modifications of such models, and new models to assist in synthesizing continuous runoff records.

Pub. Jun. 72: 63p., NTIS No. PB-214 091/1; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0302. THE EFFECTIVENESS OF FLOOD CONTROL STRUCTURE OF THE LOWER MINNESOTA RIVER WATERSHED DISTRICT

UNKNOWN, Lower Minn. Riv. Wtrshd. Dist., Savage, Minnesota 55378

Abstract: Flood protective structures in the Lower Minnesota River Watershed District, properly planned and constructed, are economical in providing protection against potential floods from the Minnesota River only for existing installations. New construction in the flood plain should include flood protection by proper location of structures as an integral part of the original design. In most cases, capital improvements should be made above the flood plain and far enough away from the main channel of the Minnesota River so as not to unduly restrict flood flows. Dikes, bulkheads, sandbagging, dams, and other structures would not be necessary if the flood plain were developed according to sound flood plain management principles. There is no economic necessity for flood protective structures on agricultural lands even though the land is flooded on an average of once a year. Agricultural use of the flood plain does not restrict high flows and is, therefore, a good use of the flood plain. Low cost flood plain management is the most economical means of reducing and eliminating both losses and the need for further protection.

Pub. Jul. 70: 244p., NTIS No. PB-196 114; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0303. WATER RESOURCES OF THE RED RIVER OF THE NORTH DRAINAGE BASIN IN MINNESOTA

R.W. MACLAY, U.S. Dept. of the Interior, Geological Survey, St. Paul, Minnesota 55414

Abstract: Water problems in the Red River of the North basin in Minnesota include flooding, pollution, and water shortages. In the morainal area, problems generally are absent; but in the flat plain of former Glacial Lake Agassiz, they can be severe. About 5.1 million acre-feet of water is perennially available. Average annual flow in streams tributary

northwest part of the basin. Regionally, ground water moves westward from morainal area to lake plain or Red River. Locally, ground water in the morainal area moves from high areas to adjacent lowlands.

Pub. Nov. 72: 141p., NTIS No. PB-218 965/2; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0304. FLOOD PLAIN STUDIES - MINNESOTA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, St. Paul, Minnesota 55414

Recurrent flooding of Minnesota streams is causing ever increasing damage to property and loss to commerce and industry. Recognizing this problem, the Legislature enacted the Flood Plain Management Act of 1969. This Act provides for a flood-plain management program to guide development of the flood plains in a manner to reduce flood damage and require local governmental units to adopt, enforce, and administer sound flood plain management ordinances when sufficient technical information is available.

Provide flood-plain information for designated reaches of streams and municipalities in a form suitable for users to establish flood-plain management measures. It will furnish a basis for the state to coordinate and evaluate the effects of the flood-plain management activities of communities in the state. Data in the forms of flood profiles, flood frequency analyses and strip maps showing the areas inundated by the 100-year flood will be prepared. Floodways designated by the state and local interests will be evaluated by the step-backwater method. Reports on significant reaches of major rivers will be assembled for state publication.

Field surveys or photogrammetry techniques will be used for obtaining valley cross-sections in urban areas. Digital computer models will be constructed using the step-backwater techniques to develop profiles of the 100-year floods. The models will be tested against available historic flood profiles and used to evaluate the effect of proposed flood plain encroachments. Profiles of the regional (100-year flood) will be devised for extended reaches of streams in predominantly rural areas based on historical floods where such data are available.

Detailed flood-plain studies for 8 communities were released to the open file. Flood-frequency profiles were developed for the lower St. Croix River which will be published jointly by the Departments of Natural Resources of Minnesota and Wisconsin. Data developed in this project will form the basis for implementation of flood-plain regulations required under the State Flood Plain Management Act. Some of the studies have indicated significant potential increases in flood stages owing to recent developments in the flood-plain areas.

Additional flood-plain studies will be made for selected communities and for major stream corridors through the Twin City metropolitan area as funds permit.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0305. FLOOD PLAIN MANAGEMENT STUDIES - LOWER MINNESOTA RIVER

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, St. Paul, Minnesota 55414

Recurring flooding of Minnesota streams causes increasing

tion is available for the delineation of flood plains and floodways. Municipalities along the lower Minnesota River suffered extensive damage in the floods of 1965 and 1969. The lower Minnesota River Valley is one of the most critical flood prone areas of the state.

The study will provide the data necessary for the development of a flood-plain management program for the lower 35 miles of the Minnesota River. It will furnish a basis for the state to coordinate and evaluate the effects of the flood-plain management activities of the several communities along the river. The profile and area inundated by the 100-year flood will be shown by a strip map. Floodways designated by the state and local interests will be evaluated by the step-backwater method. Concurrently, HUD Type 15 flood insurance studies will be made for Bloomington, Carver, and Chaska.

Photogrammetric techniques will be used for obtaining the valley cross sections and the step-backwater method employed to develop a profile for the regional (100-year) flood. A digital computer model will be constructed and tested against available historic flood profiles. The model will then be used to define the profile for the regional flood and the flood plain will be delineated on maps. The effect of proposed flood plain encroachments will be evaluated and floodway limits tested until an acceptable configuration is achieved. The accepted floodway will also be shown on the maps.

Step-backwater computations have all been completed. Flood-plain areas have all been delineated and recharge effect on the 100-year flood, resulting from proposed encroachment to the floodway limits, has been determined. Final drafting of the report and preparation of the text is nearly completed. The study has pointed out the significant amount of backwater resulting from recent developments in the flood plain, which has prompted the adoption of more restrictive measures by regulatory agencies.

Final report will be published.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0306, SOCIO-ECONOMIC IMPLICATIONS OF ALTERNATIVE WATER RESOURCES POLICIES IN MINNESOTA

J.J. WAELTI, Univ. of Minnesota, School of Agriculture, St. Paul, Minnesota 55101

The State of Minnesota has only recently undertaken significant comprehensive water resources planning activity. The State's first assessment of water and related land resources has been completed. The assessment has a time horizon of about 50 years, and represents an attempt to identify emerging problems in water and related land resources development and management.

While the assessment encompasses a time horizon of about 50 years, the State executive branch and the Legislature generally operate within a limited time horizon of two to 10 years to allocate the efforts of the State Government. In the near future, significant decisions will have to be made which will necessitate, either implicitly or explicitly, selection of policies regarding flood plain management or non-structural alternatives versus structural flood control projects; advanced waste treatment versus low flow augmentation; shoreland management versus corrective measures for water quality;

identify the economic and social consequences of alternative courses of action. 3) To evaluate the economic and social consequences of alternative actions so that a rational basis for decision making can be presented.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

6.0307, URBAN SYSTEMS - STORM DRAINAGE & FLOOD PLAIN MANAGEMENT, SANITARY SEWERAGE, SOLID WASTE MANAGEMENT (AB-BREV)

J.A. ELLIOTT, Diversified Consultants Inc., Jackson, Mississippi

Abstract: The report presents long-range plans for flood plain management and storm drainage improvements in the four-county Mississippi Gulf Region.

Pub. 1972: 173p., NTIS No. PB-212 432; PC \$10.75 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0308, URBAN SYSTEMS - WATERWORKS, SANITARY SEWERAGE, SOLID WASTE MANAGEMENT, STORM DRAINAGE & FLOOD PLAIN MANAGEMENT (AB-BREV)

J.A. ELLIOTT, Diversified Consultants Inc., Jackson, Mississippi

Abstract: The report presents the goals, objectives, and standards of the Gulf Regional Planning Commission (Hancock, Harrison, Jackson, and Pearl Counties, Mississippi) for urban systems services including waterworks, sanitary sewerage, solid waste management, storm drainage and flood plain management.

Pub. 1972: 181p., NTIS No. PB-212 429; PC \$11.25 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0309, ZONING ORDINANCE AND SUBDIVISION REGULATIONS, FRIARS POINT, MISSISSIPPI

P.J. BARLOW, State Comm. & Area Dev. Div., Jackson, Mississippi

Abstract: The zoning ordinance establishes regulations governing the use of land within the corporate limits of Friars Point, Mississippi. These regulations are designed to implement the recommendations outlined in the future land use plan for the town and to promote procedures for adoption, amendment, and enforcement. The subdivision regulations establish regulations governing the subdivision of land within the corporate limits of the Town of Friars Point, Mississippi. These regulations provide for filing subdivision plats; establish design standards; and provide procedures for adoption, amendment, and enforcement.

Pub. Apr. 72: 45p., NTIS No. PB-212 329; PC \$4.25 MF \$0.95.

SUPPORTED BY Mississippi Res. & Dev. Center - Jackson

6.0310, CITY OF JACKSON, MISSISSIPPI, WATER RESOURCES STUDY

B.E. WASSON, U.S. Dept. of the Interior, Geological Survey, Jackson, Mississippi 39205

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with the State of Mississippi.

Purpose: To provide hydrologic data which will enable planners

potential of the Wilcox Group for industrial supplies will be collected. Site studies will be made where shallow ground seepage is a problem in city construction.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0311, CITY OF JACKSON WATER RESOURCES STUDY

K.V. WILSON, U.S. Dept. of the Interior, Geological Survey, Jackson, Mississippi 39205

The occurrence of damaging floods in recent years has caused citizens and city officials to consider flood control measures and to cooperate with the USGS in collecting the basic hydrologic data on which to base a sound design. As part of a water development and management program, the city of Jackson cooperates with the USGS in appraising the ground-water resources of the Jackson vicinity in order to have this information available for possible emergency on supplemental water supplies for Jackson and for industrial prospects.

To develop flood profiles and flood-inundation maps for principal streams in the Jackson vicinity. Collect flood data for (A) hydraulic studies as requested for existing or proposed culverts, bridges, or channels in the city; (B) consultation with industrialists or others concerning flooding; and (C) preparing flood reports of unusual floods. To keep abreast of ground-water supply development and monitor the effects of withdrawals.

A network of rain gages and streamflow gages will be established to appraise flooding. Following extreme floods, special surveys of rainfall and flooding will be undertaken to supplement the gaged data. Urban flood-frequency studies, incorporating natural and land use parameters, will be made and the results used in developing profiles and inundation for selected floods. A network of selected observation wells will be monitored to follow the water-level trends in the principal aquifers. Ground-water pumpage will be inventoried periodically. Special studies concerning ground-water quality and shallow seepage will be made as their need arises.

Routine operation of gaging streams and wells was continued. An inundation map of the Jackson quadrangle (7-1/2 minute) showing limits of the 100-year flood for all major streams was completed. A special study of a rectified channel, 12 feet deep, showed that vegetation growth over the 8-year period since rectification reduced the carrying capacity of the channel by more than 300 percent at half-bankfull stages. Well records in the Jackson area were coded for computer processing.

To submit for publication an inundation map showing limits of 100-year flood for all major streams in Jackson quadrangle (7-1/2 minute). Continue coding well records in Jackson vicinity for computer processing. Update well inventory of the greater Jackson area.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0312, MODEL STUDY OF CANNELTON LOCKS AND DAM, OHIO RIVER, INDIANA AND KENTUCKY

J.J. FRANCO, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Purpose of study/investigation: To investigate navigation conditions in the lock approaches and effects of the structures on flood stages.

Approach or plan: Two models were used in this study. A 1:120-scale model reproduced about 9 miles of the river and adjacent overbank areas. A 1:25-scale model reproduced 500 ft of the lock approach channel, intake manifolds, the lock chamber, culvert, sidewall port, unifiable outlets, and 200 ft

Filling and Emptying System, Cannelton Main Lock, Ohio River, and Generalized Tests of Sidewall Port Systems for 110- by 1200-ft Locks. Hydraulic Model Investigation, was published in February 1966. A final report on the 1:120-scale model is in preparation.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0313, MISSISSIPPI BASIN MODEL

UNKNOWN, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Purpose of study/investigation: To study the coordination of releases from reservoirs, investigate the effect of reservoir operation on flood stages, check the routing of project and other floods, establish and check levee grades, predict stages, and determine the effect of floodways on stage reduction.

Approach or plan: To study various reservoir operating procedures and their effects on downstream stages and discharges. To study various levee alignments and other structures in the flood plain and their effects on stages and discharges.

Progress to date: Testing was begun in February 1951, and various testing programs have been conducted on the model since that time for the Office, Chief of Engineers, Lower Mississippi Valley Division, Southwestern Division, Ohio River Division, Missouri River Division, various State agencies, and a few private businesses. Reports of tests have been published and most are available on loan from the library at the Waterways Experiment Station.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0314, DEMONSTRATION OF THE ELECTRIC ANALOG MODEL OF THE KANSAS RIVER AT THE UNIVERSITY OF CALIFORNIA IN BERKELEY

UNKNOWN, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: An electric analog model of the Kansas River is described for studying flood flows and flood forecasting.

Pub. Jan. 63: 26p., NTIS No. AD-733 953; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0315, FORT SCOTT LAKE, MARMATON RIVER, KANSAS

UNKNOWN, U.S. Army, Engineer District, Kansas City, Missouri 63120

Abstract: Construction of a dam and lake in Bourbon County, Kansas, will provide flood protection, water quality control, water supply storage, recreation, and fish and wildlife enhancements. The lake will inundate 5,000 acres of land and eliminate 25 miles of Marmaton River and tributary streams and associated fish and wildlife habitat.

Pub. Jul. 71: 13p., NTIS No. PB-201 520-D; PC \$3.00.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0316, DEVELOPMENT OF MAGNITUDE AND FREQUENCY RELATIONSHIPS OF FLOODS ON SMALL STREAMS OF MISSOURI

L.D. HAUTH, U.S. Dept. of the Interior, Geological Survey, Rolla, Missouri 65401

Magnitude and frequency of flooding in Missouri has been adequately defined for areas draining greater than 50 square miles, but frequencies for greater than 25-year recurrence intervals have not been defined for areas draining less than 50 square miles. Peak-flow data on small drainage areas are of inadequate length to define frequency of flooding greater

(1) To define magnitude and frequency of flooding for areas draining less than 50 square miles; (2) Determine any regional patterns that may exist resulting from regression analysis of peak-flow data; (3) Determine future needs for data collection in the small-streams network.

Existing short-term rainfall-runoff data on approximately 50 small stream stations will be calibrated in a mathematical model. Long-term precipitation data will then be used to generate long-term peak-flow data. Resultant long-term peak-flow data will be fitted to the Log-Pearson Type III distribution. Regression analysis will be made using physiographic parameters to obtain optimum equations for the 2-, 5-, 10-, 25-, 50-, and 100-year flood.

Project is 95 percent complete. Report is in colleague review to complete report.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0317, HYDROLOGY OF STREAMS IN ST. LOUIS METROPOLITAN AREA

D.W. SPENCER, U.S. Dept. of the Interior, Geological Survey, Rolla, Missouri 65401

Four major drainage basins in the metropolitan St. Louis area are now being used to drain uncontrolled storm water from many urbanized areas. Storm waters carried away by these streams are increasing with increased urbanization, causing greater flooding and erosion. Little or no information on the hydrologic characteristics of these basins is available, nor is any available on the effects of urbanization on the basins runoff. Knowledge of the hydrologic characteristics and the effects of urbanization will be a valuable tool in the economic and effective design of channel improvements now and in the future.

Furnish designers and planners basic information on the hydrologic characteristics of the project basins. To analyze basic hydrologic data to determine frequency of flooding and effects of urbanization upon the rainfall-runoff relationship.

Approximately 100 crest-stage gages will be constructed along each stream to record flood profiles. Through interview of local residents historic flood elevations will be used to develop flood-inundation maps. Continuous recorders placed near the mouth of each basin will provide stage-discharge relationships that will indicate basin discharge. Flood-hydrograph recorders with synchromous continuous rainfall recorders located near the confluence of each basin along the stream channel will be used as an aid to define urbanization effects. Urbanization effects will be shown by relating lag time between mass of rainfall and mass of runoff to basin characteristics.

Flood data on historical events outside the period of record has been collected in all basins and reports published. Stage-discharge relations have been established at about 75 percent of the gages. Basin parameter determination is about 50 percent complete.

Continue collection of rainfall, stage, and discharge data. Analysis of data for a report on rainfall-runoff relationship. Reduce the number of recording gages to the ones that have ratings or the best chance of rating. Enter all data gathered to date on disk storage and commence calibration runs and runoff calculations on long-term rainfall.

Construction of flood-control reservoirs and the allocation of capacity in multi-purpose reservoirs for flood control have increased in recent years. Growth in numbers and capacity of flood-storage projects appears to be continuing. Additional data are needed for the planning, design, construction, and operation of projects that include the storage of flood waters.

The objectives of the study are to present (1) processed flood-volume-recurrence data for all long-time continuous-record stations and those short records that can be extended by regression analysis; (2) Regional equations for the estimation of flood-volume-recurrence data at ungaged sites.

The analysis will be made by using methods outlined by G.A. Kirkpatrick and H.C. Riggs in administrative reports prepared in the hydrologic studies section. The Log-Pearson Type III distribution will be fitted by computer to the logarithms of the tabulated highest mean discharges for various durations to obtain flood-volume-recurrence data for each station. Special emphasis will be placed on recently available data from drainage areas of less than 50 square miles. When all station data have been analyzed, regional equations for plains and plateaus will be defined by utilizing STATPAC computer programs.

During 1973 fiscal year computer work was completed and regional flood-volume equations for the plains and plateaus were finalized. Work was completed on the report manuscript, colleague reviews were obtained, and the manuscript received approval by regional staff and Director's Office. Publication as a report in the Water Resources Report Series of the Missouri Geological Survey occurred near the end of the fiscal year.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0319, HYDROLOGY OF STREAMS IN ST. LOUIS COUNTY - MISSOURI

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Rolla, Missouri 65401

As the population of St. Louis City declines the population of St. Louis County increases. Substantial changes are being made in the use of land in the rural areas. Storm-water drainage is one of the principal problems. Inadequate data for planning of roads, use of flood-plain areas, zoning ordinance on land use and channel improvements necessitate collection of data suitable for flood-inundation maps and other analyses.

To determine the effects of urbanization on runoff from small streams in St. Louis County, Mo.

Reconnaissance of streams which drain the areas that will be affected by urbanization will be made to determine the number of data collecting sites needed for definition of the hydrologic characteristics of the area. Flood data will be collected at many sites on a continuing basis to define flood frequencies, flood profiles, channel shapes and capacities, flow characteristics and other factors needed to study the suburban-rural hydrology. Gaging stations, crest-stage gages and precipitation stations will be installed at a sufficient number of sites to furnish the data needed for the analysis outlined above.

Data collection sites and basin parameter calculations have been completed. Stage-discharge relationships are being

RIVER BASIN, MERAMEC RIVER, MISSOURI
UNKNOWN, U.S. Army, Engineer District, St. Louis, Missouri
63120

Abstract: An appendix to the environmental impact statement draft for Meramec Park Lake on the Meramec River, Missouri, contains information on area flooding, earthquakes, water wells, soils, flora and fauna taxonomy, aquatic biota, wildlife, and aquaculture.

Pub. Apr. 73 144p., NTIS No. EIS-MO-73-0996-D-2: PC \$9.25.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0321, FLOODPLAIN MAPPING AND PLANNING FOR THE 50 AND 100 YEAR INTERVAL FLOOD ZONES OF THE BITTERROOT VALLEY, MONTANA

K.M. NOLAN, Montana State University, Water Resources Research Ctr., Bozeman, Montana 59715

Abstract: Flood hazard maps, delineating 50-year and 100-year flood plain areas, were prepared for an 80-mile reach of the Bitterroot River in Western Montana. Discharge rates corresponding to 50-year and 100-year recurrence frequency were obtained for six stations on the river using graphical methods suggested by the U.S. Geological Survey. River stage was monitored at 15 locations in the reach for a 14-day period during the June 1972 snowmelt runoff season to develop simulated rating curves. Aerial photographs of the reach were taken on June 1, 1972 when the river was in flood stage but before the snowmelt peak had occurred. The photographs were used in conjunction with the ground control sites to establish flood boundaries corresponding to 50 and 100-year floods.

Pub. Oct. 73 103p., NTIS No. PB-226 082/6: PC \$4.25 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0322, EVALUATION OF FLOOD PEAK PREDICTION METHODS IN SEMI-ARID REGIONS IN RELATION TO DAM SAFETY

A.B. CUNNINGHAM, Univ. of Nevada, Desert Research Institute, Reno, Nevada 89507

Various commonly used methods of flood peak prediction for ungaged basins will be applied in two hydrologically dissimilar regions of Nevada. Results will be analyzed with regard to making the following comparisons. First, the relative differences resulting from the application of the various prediction procedures to individual study area watersheds will be determined. From this information generalizations will be made as to the magnitude of variation which can be expected in the use of particular prediction methods in semi-arid areas. In addition, comparisons of the flood peak recurrence interval values produced by each method for all study watersheds will be used to determine the degree of variation to be expected for each particular prediction method. Final results and comparisons will be evaluated with regard to current dam and spillway safety criteria.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

6.0323, HYDROLOGY OF SUBURBAN AREAS - NEW JERSEY

K. NATHAN, Rutgers the State University, Agricultural Experiment Sta., New Brunswick, New Jersey 08903

The effect on the rainfall-runoff relationship on small watersheds in central New Jersey as the land use changes from agriculture and forestry to suburban development is

water and soil resources in agricultural areas undergoing urban development will be determined. Rainfall will be measured by recording rain gages with punched paper output. Runoff will be obtained by means of stage recorder with punched paper output. Pertinent parameters of the watershed will be determined from available aerial photographs and contour maps. Surveillance on land use will be kept by inspection.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY New Jersey State Government - TR

6.0324, ECONOMIC BASIS FOR WATER RESOURCE ANALYSIS

W. WHIPPLE, Rutgers the State University, Water Resources Research Inst., New Brunswick, New Jersey 08903

Abstract: The work provides improved economic principles and methodology for water resources planning. A basic objective function is proposed, which can be quantified for special cases where income redistribution is relevant. A stochastic approach is developed to provide a quantitative utility function of uncertainty, based upon social value at risk inferred from insurance and other fields. The uncertainty and theory of opportunity costs is used to derive a discount rate to government discount rate, and to the cost of taxation in comparisons of projects with alternative uses. In the field of hydroelectric power, it is shown that these principles will approximately halve traditional benefit-cost estimates. A special study of flood control provides a new approach to optimal degree of protection, and to flood plain management through consideration of project-induced investment in hazard areas. Essential principles are given for an evaluation of the benefits of pollution control and a methodology for optimizing planning including water quality objectives.

Pub. Jun. 68: 128p., NTIS No. PB-203 346: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0325, FLOOD PLAIN AND PEAK FLOW STUDY - NEW JERSEY

T.G. ROSS, U.S. Dept. of the Interior, Geological Survey, Trenton, New Jersey 08607

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with the State of New Jersey.

Purpose: To provide information on the extent and frequency of floods.

Methods: Crest-stage gages are installed at key sites on the river to collect flood peak data. A rating curve for each gage is defined by discharge measurements. Historical flood data are obtained by interviews with local residents, state and federal agencies. Field surveys are made to obtain cross-sections, flood profile, thalweg, and bridge data. Flood frequency analyses are made and maps prepared.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0326, DETERMINATION OF FLOOD PEAKS, FREQUENCIES, PROFILES, & FLOOD INUNDATION - NEW JERSEY

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Trenton, New Jersey 08607

The N.J. Department of Environmental Protection, Division of Water Resources, has requested an updated study on the magnitude and frequency of floods in N.J., including effects of urbanization. The Division of Water Resources

the county of Bergen need flood information on small watersheds for investigative and planning purposes. The statewide program for flood-plain regulation and flood insurance and the need to resolve past conflicts between the Bureau of Public Roads, N.J. Dept. of Transportation, and the Division of Water Resources as to design criteria for bridge waterway openings require this comprehensive regional study.

Update and refine previous study of the magnitude and frequency of floods in N.J. (Water Resources Circular 13, published by N.J. Division of Water Policy and Supply in 1964) to include subsequent years of flood data and to extend coverage to watersheds as small as one square mile and to quantify the effects of urbanization on flood magnitude and frequency in the past, at present and in the future. Collect high water data and flood marks for significant storm events and publish peak discharge at 51 sites in annual reports of USGS.

Annual peaks for entire period of record and selected time increments will be analyzed in terms of Log Pearson Type III and studied in relation to quantitative indices of urbanization estimated for corresponding time periods for gaging stations in N.J. Coefficients for increase in size of floods for varying degrees of urbanization will be developed. Regionalization of station flood-frequency by multiple regression will be attempted using both natural and urban-related basin characteristics so as to provide for usable estimates of spatial as well as future flood magnitude and frequency based on population projections.

Seven new crest-stage partial-record stations were established. Rating curves were developed for these stations and updated for 54 other crest-stage stations. Discharges were published in annual report of USGS. Flood-frequency curves were updated and defined for 114 gaging stations based on the most recent annual peak data and improved analytical techniques. A preliminary method was developed, estimating flood-peak magnitudes having recurrence intervals ranging up to 100 years for ungaged basins greater than 1 sq. mi. with various degrees of urban and suburban development. (Text Abridged)

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0327. FLOOD FREQUENCY STUDY IN NEW MEXICO

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Albuquerque, New Mexico 87106 (2R23001616)

Hydrologic data are being obtained and analyzed to relate the magnitude, volume and frequency of floods for drainage areas of less than fifteen square miles to basin parameters. Representative basins to include ranges of topographic, geologic and climatic characteristics will be measured in detail and methods devised for transferring information to other basins.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

6.0328. THE USE OF SYSTEMS ANALYSIS IN THE DEVELOPMENT OF WATER RESOURCES MANAGEMENT PLANS FOR NEW YORK STATE - VOLUME I

A.C. TEDROW, State Div. of Water Resources, Albany, New York 12226

New York, was used as the vehicle for carrying out the project. In applying systems analysis techniques to the river basin, a number of models were constructed. Management programs were analyzed on two different time bases; one, an overall budgeting or allocating of waters to various purposes on a long time interval and the other, the operation of the physical system on a transient basis during flood periods. As a result, a monthly or 'conservation' simulation model, a monthly optimization model, and a flood simulation model were developed. The flood routing model was a mathematical representation of a hydraulic system and consisted of the lakes and reservoirs in the Oswego River Basin and their connecting waterways.

Pub. Jun. 70: 145p., NTIS No. PB-199 539; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0329. STREAMS AND DRAINAGE BASINS - FULTON COUNTY, NEW YORK

UNKNOWN, State Off. of Plan. Services, Albany, New York 12207

Abstract: The report indicates the methodology used in measuring and delineating the drainage basins of all streams in Fulton County. The report contains a sample for one basin with map and figures. In addition, the report includes potential impoundment areas and existing flood prone areas in Fulton County.

Pub. Dec. 70: 45p., NTIS No. PB-201 884; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0330. PUTNAM COUNTY OFFICIAL MAP - PROPOSALS FOR REVISION AND EXPANSION

UNKNOWN, State Off. of Plan. Services, Albany, New York 12207

Abstract: The Official Map for the County of Putnam was established to enable the County to utilize certain regulatory powers which are essential if orderly growth and development are to be ensured throughout the County. This map also provides the means by which adequate facilities for the safe, convenient and efficient vehicular movement of people and goods can be achieved and for the protection of the public from flood damage. These matters are considered to be in the interest of the public, for the promotion of the safety, convenience and general welfare of the County. The Putnam County Official Map facilitates the planning and development of County roads, public sites and drainage systems by the protection of rights-of-way that will be needed for the widening, realignment or construction of new or existing County roads, public sites and the protection of drainage systems from encroachment or excessive runoff.

Pub. Jun. 71: 52p., NTIS No. PB-197 771; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0331. FLOOD INVESTIGATIONS - NEW YORK

B. DUNN, U.S. Dept. of the Interior, Geological Survey, Albany, New York 12201

Provide information on magnitude and frequency of flood events to agencies and individuals involved in various phases of flood planning and design. Develop regional flood frequency relationships for the entire State of New York.

Flood data will be collected at crest-stage stations, and annual peak discharges will be published. Discharge will be determined for flood events. Flood profiles will be defined, and information on flood plain mapping will be collected. Reports will be prepared covering individual events as well as an annual summary of floods. As data becomes available, an analysis will be made to improve flood frequency relationships for the state.

Annual flood summary work continued. Several bridge site and highway alignment studies were made. Major effort was devoted to collecting and compiling data for areas affected by June 1972 floods. Indirect measurements of discharge were made, flood profiles determined, 39 flood maps were prepared and 2 hydrologic atlases were prepared.

Annual flood summary report for 1972 will be completed and that for 1973 prepared. Several bridge site and highway alignment reports will be prepared. Flood frequency analyses will be made and list of maximum stage and discharges will be updated.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0332, COMPREHENSIVE PLAN - REPORT C, IMPLEMENTATION - VILLAGE OF EAST AURORA, N.Y., TOWN OF AURORA, N.Y.

UNKNOWN, Aurora Planning Board, Aurora, New York 13026

Abstract: The resultant Comprehensive Plan for East Aurora, and Aurora, New York, includes proposed Land Use Plans for the Village and Town, Street and Highway proposals, with emphasis on the reduction of through-traffic in residential neighborhoods in the village; a special study on the relation of surface water drainage, public sewer and water to land forms and soil types, with a timetable for development; alternative plans for residential subdivision; and a Community Facilities Plan with suggested park designs. The Implementation section, in addition to its discussion and recommendations concerned with regulatory measures and finances, proposed amendments to the local zoning ordinances and official map which include a 'flood plain sector' in the village and a 'conservation sector' in the town.

Pub. Jun. 70: 123p., NTIS No. PB-192 382: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0333, NATURAL CHARACTERISTICS OF COLUMBIA COUNTY, NEW YORK STATE

H.H. LADAGE, Columbia Co. Planning Dept., Hudson, New York 12534

Abstract: Topography, slope, flooded areas, swamps, wooded areas, drainage and areas of distinctive vistas were examined. The material obtained in the study will be used to guide development, aid in developing a County Comprehensive Plan and also to form the basis for an environmental study.

Pub. May 72: 49., NTIS No. PB-213 708/4: PC \$4.50 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

A three phase research program over a two year period is envisioned. The first phase should produce two results: (1) an evaluation of recent performance of institutional arrangements for flood risk management from several points of view; and (2) a specification of the flood management strategy that is currently seen as ideal in our conventional wisdom. The second phase should produce a critique of the 'conventional ideal strategy' based upon an improved understanding of institutional behavior. Inter-organizational relationships, political and administrative processes will be studied to identify why this strategy is not applied and what institutional changes would be necessary to actually achieve it. The third phase should produce an improved ideal strategy and the specifications for institutional redesign needed to attain it. This improved ideal strategy will hopefully provide a better blend between technical efficiency and political reality.

SUPPORTED BY U.S. Dept. of Interior - O. Wt. Res. Rech.

6.0335, STUDIES IN THE ANALYSIS OF METROPOLITAN WATER RESOURCE SYSTEMS - VOLUME IV - MODELS FOR MANAGING METROPOLITAN SURFACE WATER SYSTEMS

J.R. FERGUSSON, Cornell University, Water Resour. & Marine Sc. Ctr., Ithaca, New York 14853

Abstract: The report is the fourth of a sequence of studies using optimization and simulation techniques to analyze a variety of metropolitan water resource problems. The first chapter discusses some linear or separable programming models for defining and analyzing alternative investment and operating policies for regulating and allocating metropolitan surface water supplies and for the reduction of flood damages. The second chapter reviews a variety of surface water quality management models for rivers, lakes and estuaries. The third and final chapter is a state-of-the-art paper on models for the control of flood flows and reduction of flood damages.

Pub. Feb. 72: 240p., NTIS No. PB-209 209: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0336, THE POLITICAL ECONOMY OF WATER RESOURCES

D.J. ALLEE, State University of New York, Agricultural Experiment Sta., Ithaca, New York 14850 (NYC-121432)

Objective: Develop and apply principles for water resources management that relate the concepts of economics, political science, public administration, and other disciplines. Identify alternative strategies of public water resources management and their likely effects. Identify and evaluate changes in institutional arrangements for water and related land resources, including policy and budget-making processes, interest group accommodation and conflict processes and the law of property and public regulation.

Approach: Individual problem areas will be isolated and explored in reaction to the internal logic of each problem area. Initial emphasis will be on: coordination of Federal and State policy making, public participation in planning, environmental problems in basin management with emphasis on lakes and planning methodology with special emphasis on supply and demand factors, and relating planning to program budgeting.

MAJOR DISASTER TYPES

vironmentalists. The result would be a stronger role for the states and particularly the governors, through basin commissions. Also, progress on a review of cost-sharing for waste treatment and flood control, produced some recommendations for federal and state programs, including flood insurance. Basin planning and management arrangements need citizen support and alternative approaches for achieving this have been developed based upon case studies of New England and Delaware. Also, the strategies open to Basin Commissions to become politically viable were identified. A review of population policy issues and how they might affect federal water programs was completed.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

6.0337, APPLICATION OF LUNR SYSTEM TO FLOOD PLAIN ANALYSIS AND MANAGEMENT IN THE SUSQUEHANNA RIVER BASIN

J.W. KELLEY, State University of New York, Agricultural Experiment Sta., Ithaca, New York 14850 (NYC-147313)

Objective: Develop a procedure for utilizing technical aspects of New York State Land Use and Natural Resources (LUNR) system more effectively in water resources planning and more specifically in terms of flood plain management in the Susquehanna River Basin.

Approach: The Elmira-Horseheads New York region will be the study area. The research will include manipulation of actual LUNR inventory data, identification of decisions and display procedures. Emphasis will be placed on flood plain identification and characterization via remote sensing, data use for water planning needs and an evaluation of feasibility of developing an improved LUNR system for the Susquehanna River Basin.

SUPPORTED BY New York State Government - Albany

6.0338, HYDROLOGIC EFFECTS OF URBANIZATION IN THE UNITED STATES

M.B. MCPHERSON, Amer. Soc. of Civil Engrs., New York, New York 10017

Abstract: The contents include the following topics on urbanization's effects upon hydrology: Urbanization indicators; Character of precipitation; Micro-scale climatic effects; Major effects resulting from urban water resources facilities; Projected impact of community-scale urban water conservation measures; Water supply impact; Flooding effects; Pollution effects; Effects of mining activities; Effects of other water-body uses; Water balance inventories; Outline for selected case studies.

Pub. Jan. 72: 54p., NTIS No. PB-212 579; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0339, URBAN RUNOFF

M.B. MCPHERSON, Amer. Soc. of Civil Engrs., New York, New York 10017

Abstract: The report is a review of the effects of urbanization on hydrology. Topics discussed include the following: Urban stormwater disposal; Land-use changes; Morphological changes in drainage; Changes in flood characteristics; Flood mitigation versus the amenities of drainage; Some management possibilities; Research status and needs.

Pub. Aug. 72: 53p., NTIS No. PB-212 580; PC \$3.00 MF \$0.95.

Abstract: The report presents an analysis of the four drainage basins within the Genesee/Finger Lakes Region. It provides basic information that will be utilized in planning and recommendations for the Region. A brief description of the area, topography, climate, population and other factors introduces the inventory of the Lake Ontario, Oswego and Erie-Niagara Drainage Basins. The Lake Ontario drainage study is devoted to a detailed description of the major lakes, rivers and streams in the four drainage basins. Pub. Oct. 69: 144p., NTIS No. PB-194 682; HC \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0341, EROSION AND DEPOSITION IN THE COASTAL AND ESTUARIES OF THE NORTH CAROLINA

R.L. INGRAM, Univ. of North Carolina, School of Civil Engineering, Hill, North Carolina 27514

The objectives of this project are: (1) to determine the factors that are taking place in the bottom topography and shorelines of selected study areas typical of the estuary environment of the North Carolina coast, especially Pamlico Sound, (2) to study the erosional and depositional processes responsible for these changes, and (3) to predict future changes.

How information will be applied: Information generated by this program will be used by State and Federal agencies to predict the effects on erosion and deposition of (1) changes in river regime from floods, droughts, dam construction, conservation practices; (2) opening and closing of dredging activities; (3) construction of shoreline stabilization; (4) shoreline mining.

Accomplishments during the past twelve months: Over 100 aerial photographs of the study areas have been obtained and are being studied. Detailed bathymetric tracing has been made. The heavy mineral content of 173 samples has been used to estimate the source of the sands being deposited in the sounds and estuaries. The clay mineral content of 173 samples has been used to estimate the source of the silts being deposited in the sounds and estuaries. Bottom samples are being taken in the study areas.

SUPPORTED BY U.S. Dept. of Commerce - N.O.

6.0342, EFFECTS OF URBANIZATION ON FLOODING IN CHARLOTTE, NORTH CAROLINA

W.H. EDDINS, U.S. Dept. of the Interior, Geological Survey, Raleigh, North Carolina 27607

The City of Charlotte is faced with the problems of flooding and damage resulting from flooding of small streams and the need for flood-profile elevation so that new developments will not be subjected to flood damage. The problems include design of small bridges, culverts, sewers, and stream-channel improvements under existing conditions of the higher-peak flows associated with development. In the extended project beyond July 1972, the problem of flood-plain use and the alternatives of defining floodways are paramount.

Hydrologic data before and after urban development are usually unavailable. Therefore, rainfall and runoff data for watersheds that are in the same region but in different stages of urbanization will be used for analysis and correlation with the data for the study area.

6.0343.

Continuous rainfall and runoff data will be recorded concurrently at selected sites. The recorded data will be used in conjunction with long-term rainfall data to generate expected long-term runoff data. The generated data and observed short-term data along with observed long-term data in the region will be used in several linear regression models for determination of relationship to basin characteristics for which physical factors and changes can be evaluated. Significant factors will be combined in formulas for peak runoff having selected recurrence intervals. After June 1972, the peak runoffs will be used in step-backwater and other studies to define flood profiles and floodways.

A report, B1132, defining the effect of urbanization on flooding, was published during the fiscal year. A study was completed showing the percent of impervious cover found in typical urban and exurban environments. Work has progressed in delineating flood boundaries along many streams in the area. The first set of flood maps, those for McMullen creek, were released to the cooperators.

It is planned to complete and release 100 maps defining flood profile and floodways along all stream with a drainage area of one square mile, or more. (Text Abridged)

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0343. EFFECTS OF URBANIZATION ON FLOODS AT MORGANTON, NORTH CAROLINA

A. I. PUTNAM, U.S. Dept. of the Interior, Geological Survey, Raleigh, North Carolina 27607

The City of Morganton (as most cities) is faced with problems of drainage and damage resulting from flooding of small streams. Drainage problems include design of small bridges, culverts, storm sewers, and stream-channel treatment. Because of urban developments in the basin and flood-plain encroachment, many areas which were formerly rarely inundated are now flooded with increasing frequency.

Hydrologic data before and after urban development are usually unavailable. Therefore, rainfall-runoff data from watersheds that are in the same region but in different stages of urbanization will be used for analysis and comparison to: (1) Evaluate quantitatively the flood potential of urban watersheds smaller than 5 square miles. (2) Derive usable relationships for determining peak discharge from small urban watersheds by evaluating the effect and relation of various natural and urban characteristics.

Continuous rainfall and runoff data will be recorded concurrently at selected sites. The recorded data will be used in conjunction with long-term rainfall data to generate expected long-term runoff data. The generated data and observed short-term data along with observed long-term runoff data in the region will be used in several linear regression models for determination of relationships to basin characteristics for which physical factors and changes can be evaluated. Significant factors will be combined in formulas for peak discharges having selected recurrence intervals.

Analysis of the data for this project has been completed, and preparation of the final report has been started. Previously investigators have used a family of curves, each depicting a different degree of urban development, to relate basin lag time to the stream length divided by the square root of the stream slope. For this project the ratio of the area of impervious cover to the total drainage area was included in the analysis to define the basin lag time equation. As a result, only one curve is required to depict any degree of urban

O.A. CROSBY, U.S. Dept. of the Interior, Geological Survey, Bismarck, North Dakota

There was no information on frequency and magnitude of small-stream floods in the state at the time of the study. The methods being used to obtain hydrologic information and culvert design were unsatisfactory. Design procedures were especially critical on flood runoff from small watersheds.

To provide guidelines for culvert and bridge design, a study of hydrologic data currently available, to obtain a general history of hydrologic data on small watersheds to supplement the data currently available, to obtain a general history of hydrologic events for a period of time, and to provide a complete and usable report for future culvert and bridge design.

A report on magnitude and frequency of floods was prepared from existing data. Seventy-nine small watersheds are instrumented for the collection of peak flow data. Parameters that may have an effect on flood magnitude are measured. All major flood events will be documented in a comprehensive analytical report utilizing all data currently prepared.

Peak stage and flow data were collected at all sites. A report completed on determination of drainage areas and basin parameters. Peak flow data were published in the report "Water Resources Data for North Dakota, Part 1." The report has commenced an analysis of the data.

A frequency report will be completed based on the study. Program objectives will be reevaluated. Peak stage and flow data will be collected during the year.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0345. COST-EFFECTIVENESS ANALYSES OF REGIONAL FLOOD PLAIN MANAGEMENT ACT

G.M. CLARK, Ohio State University, School of Civil Engineering, Columbus, Ohio 43212 (C-4184)

The key element in the proposed research is the development of a dynamic feedback model which describes regional economic development, recreational facility utilization, flood damage phenomena, and hydraulic and hydrologic characteristics of the region. The model will be constructed to explicitly evaluate the following aspects of a regional flood plain management program: 1) land use controls; 2) definition of the flood plain and floodway; 3) flood plain utilization of the flood plain; 4) level of administrative and technical assistance provided local communities; 5) flood insurance and flood proofing; and 6) potential of flood control projects.

The model will accept input data which describes: 1) the methods of flood plain management available in the region; 2) the nature and extent of flood prone areas in a region; 3) the attitudes of flood plain occupants and other interested parties regarding key aspects of flood plain management.

A time history of the dollar and noddollar costs arising from alternative programs of regional flood plain management will be predicted. The levels of important economic indicators will also be predicted to give the decision maker a clearer insight into the overall effect of the flood plain management program. As the final product of the proposed research, the model will be applied to a flood prone region in Ohio.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res.

In designing a flood plain management program, the program alternatives that must be considered consist of various procedures for delineating the flood plain, methods of data processing, and techniques for data collection. Cost and effectiveness criteria are needed to evaluate these alternative flood plain management programs. The cost to implement a particular program can be predicted using objective information. Conversely, subjective opinions must be used to estimate relevant effectiveness measures. Research is being conducted to explore various methods of measuring program effectiveness, and the effect of these measures on ultimate program design.

SUPPORTED BY Ohio State University

6.0347, DETERMINATION OF COST-EFFECTIVE TECHNICAL PROCEDURES FOR USE IN THE OHIO FLOOD PLAIN MANAGEMENT PROGRAM

G.M. CLARK, Ohio State University, School of Engineering, Columbus, Ohio 43212

The objective of this research has been the determination of cost-effective technical procedures which can be efficiently used in the proposed Ohio Flood Plain Management Program. The recommendations in the final report represent a ten-year technical plan for use by the Ohio Flood Plain Management Program. These recommendations are derived from an analysis of program requirements and a program effectiveness model developed for this research. The first phase of the program can be immediately implemented to conduct engineering analyses of flood prone areas, through delineation of areas subject to periodic flooding and evaluation of flood-plain encroachments on flood elevations.

SUPPORTED BY Ohio State Government - Columbus

6.0348, STREAMFLOW SIMULATION AND FLOOD PROFILE DETERMINATION IN OHIO - A PILOT STUDY

V.T. RICCA, Ohio State University, School of Engineering, Columbus, Ohio 43212

A pilot study on the practical application approach of: Utilizing digital computer models for: (1) Streamflow simulation (small urbanizing watersheds with refined data and large watersheds with coarse or limited data) and (2) Stream hydraulics analysis including normal depth, backwater curves for water surface elevations, and localized channel restrictions (bridge abutments, landfills, etc.). Also studied: Employing conventional methods (computer assisted where practical) for ascertaining required data for models: hydrologic, climatic, and geomorphologic for streamflow simulation; channel cross-sections, roughness coefficients, and bed slope for the stream profile determinations; and flood flow frequency analysis. The aim is to delineate zones of probable inundation.

SUPPORTED BY Ohio State Government - Columbus

6.0349, FLOOD HYDROLOGY OF SMALL DRAINAGE AREAS

E.E. WEBBER, U.S. Dept. of the Interior, Geological Survey, Columbus, Ohio 43212

Knowledge of the frequency and magnitude of floods is a prerequisite to the economic design of highway drainage

The purpose of this project is to supplement the existing project of flood studies and analyses to obtain an adequate measure of flood characteristics for drainage areas of less than one square mile. When sufficient length of record is available, data will be analyzed to establish flood-frequency relationships for small drainage areas, as a basis for improving currently available methodology.

Crest-stage gages will be established at 20 culvert sites. Theoretical stage-discharge relations will be defined by computer analysis. Annual maximum stages and discharges will be documented until sufficient data are obtained for reliable definition of flood frequency relations (about ten years). High-flow current-meter measurements and indirect peak discharge measurements will be obtained to check the theoretical stage-discharge relations. Combined stage and precipitation recorders will be installed at about 5 of the 20 sites. Final report will be a regionalized flood-frequency report for small drainage areas.

Annual peak stages and discharges were obtained, summarized, and published in the annual basic data release. Records of combined stage and precipitation continued to be obtained at five sites on drainage areas ranging from 0.3 to 11.0 square miles. An administrative report based on the five years of record available at the 20 small-area crest stage stations was prepared, and copies distributed to interested parties.

Operation and maintenance of the network of small-stream crest-stage gages and combined stage and precipitation recorders will be continued.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0350, APPRAISAL OF THE WATER AND RELATED LAND RESOURCES OF OKLAHOMA - REGION EIGHT - 1971

UNKNOWN, State Water Resour. Board, Oklahoma City, Oklahoma 73112

Abstract. The water and land resources of Region Eight of Oklahoma are described. Topics discussed include a comprehensive development plan; history; geology; soils; hydrology and climatology; National Severe Storms Laboratory; surface water; watershed and floods; and ground water.

Pub. 1971: 143p., NTIS No. COM-71-00511; PC \$3.00 MF 00.95.

SUPPORTED BY U.S. Water Resources Council - Wash., D.C.

6.0351, APPRAISAL OF THE WATER AND RELATED LAND RESOURCES OF OKLAHOMA

UNKNOWN, State Water Resour. Board, Oklahoma City, Oklahoma 73112

Abstract. This is the ninth in a series of twelve reports which are part of the first phase of gathering information basic to the eventual state-wide water plan. Various aspects of the needs and assets of the area in north central Oklahoma are described and discussed. Information is given on the geology, soils, hydrology, climatology, surface water, watershed protection and flood prevention, ground water, water quality, agriculture, manufacturing and industry, oil and gas, power and fuel, recreation and wildlife, etc. Maps, charts and tables provide data summaries for the region.

6 0353.

UNKNOWN, Clatsop Tillamook Intergov., Cannon Beach, Oregon 97110

The study describes flooding problems, both tidal and river, of the District and provides considerations and recommendations to help minimize flooding damage. Sample flood plain and geologic hazard ordinance information, river cross-section data, along with examples of building permit waivers for geologic hazard, ortho-photo flood plain maps of a scale 1" equals 400' of selected rivers in the District, copies of which may be obtained at either the Clatsop or Tillamook County Courthouse. An extensive bibliography is provided should additional information be required.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0353. A COMPILATION OF FLOOD ABATEMENT PROJECTS IN OREGON

RE EMMER, Oregon State University, Water Resources Research Inst., Corvallis, Oregon 97331

Abstract: The report is designed to serve as a convenient inventory of and reference to flood abatement projects in Oregon. It presents an organized compilation of the location, capacity, and type of flood abatement projects within the state. The report is in the following format. An introductory section outlines the major factors which influence flooding in Oregon. The bulk of the report treats flood characteristics and projects in Oregon on a watershed by watershed basis. Each chapter concludes with a list of flood abatement projects within the basin.

Pub. Dec. 71. 123., NTIS No. PB-206 307. PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0354. DEVELOPMENT IN FLOOD-PRONE AREAS OF LINCOLN COUNTY, OREGON AUGUST, 1973

UNKNOWN, Lincoln Co. Planning Dept., Newport, Oregon 97365

The report discusses the dangers of flood plain development, reviews the local ordinances which intend to diminish flood hazards, and discusses the federal flood insurance program and the Lincoln County flood level management program.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0355. AN EVALUATION OF HURRICANE AGNES FLOODS IN COMPARISON TO BRIDGE DESIGN INFORMATION AVAILABLE FOR PENNSYLVANIA CONTEMPORANEOUSLY

B.M. REICH, Unknown Inst. or Indiv. Grant, Pennsylvania

Abstract: In the years 1970, 1971, design manuals had been issued for State of Pennsylvania on prediction of extreme rainfall and anticipated floods. On June 22, 1972, Hurricane Agnes dumped 13 inches of rain in five days, producing very severe floods. The report presents the results of comparison of extreme floods statistically predicted to actual floods caused by Hurricane Agnes.

Pub. May 73. 58p., NTIS No. PB-220 888. PC \$3.00 MF \$0.95

Abstract: The report gives a comparison of the performance of two recently developed methods for predicting floods in Pennsylvania: (1) PSU method - by Dr. Reich, Geologist, Geosociates at Pennsylvania State University for rivers up to 200 square miles in size (2) PAGE method - by the Geological Survey for rural watersheds up to 200 square miles in size. Flood flows estimated for these methods for 42 selected watersheds in Pennsylvania, ranging from 200 square miles in size and 28 to 60 years return period, were compared with the observed data for the years 2, 10, 25, and 50 years.

Pub. Feb. 72. 115., NTIS No. PB-208 46. PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Transportation - FHWA

6.0357. THE EFFECT OF GROUND-WATER FLUCTUATIONS ON LOCAL FLOODING IN THE HARRISBURG AREA, PENNSYLVANIA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Harrisburg, Pennsylvania 17104

Since all coal mining operations have ceased in the Harrisburg Valley, the mines have filled with water causing a rise in normal ground water levels in the study area. Many of the basements were built during the mining era and have basements that extend down into the water table. The present water table fluctuation. Since 1967 periodic heavy rainfall have frequently caused many basements to flood.

To determine the source and movements of ground water, the seasonal fluctuation of the water table, the delineate areas and degree of basement flooding, the factors that control the surface and subsurface water through the above defined areas so that a plan to alleviate flooding can be proposed and evaluated.

Continuously monitor the ground-water level in the basements, and wells to be installed. Prepare a map of the zone of water-level fluctuation. Determine the routing of water in the study area by monitoring, gaging stream flow and conducting seepage measurements, prepare model of area to evaluate alternative plans.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0358. FLOOD-PROOFING REGULATIONS AND STANDARDS FOR BUILDINGS AND STRUCTURES IN PENNSYLVANIA

UNKNOWN, U.S. Army, Engineer District, Harrisburg, Pennsylvania

Existing building codes and regulations do not provide special flood-proofing requirements and minimum standards for design and construction that should be met for structures susceptible to flood damages. A national effort has long been recognized at all levels of government and in the private sector. However, little has been done to develop or assemble information on flood-proofing into a workable set of standards that can be of national application. Under its Flood Plain Management Program, the Corps of Engineers has taken the first step towards meeting this need by developing minimum standards of design and construction for flood-proofing of buildings and structures.

building codes and regulations. If, on the other hand, a separate 'floodproofing code' for direct adoption by States and local governments is desired, the flood-proofing information contained herein is also sufficient for that purpose.

Pub. 1972: 80p., U.S. Army, Corps of Engineers.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Defense - Army

6.0359, ALTERNATIVE ADJUSTMENTS TO NATURAL HAZARDS

D.G. ARRY, Univ. of Pittsburgh, Graduate School, Pittsburgh, Pennsylvania 15213

Abstract: The authors review and suggest possible changes in Federal water resources policies and programs for reduction of losses from floods, drought, and hurricanes. Federal flood control policy is reviewed, leading up to the analysis of alternatives contained in the 1966 report of a task force on Federal flood control policy which is leading to changes in Federal policy. Response to the drought of the mid-1960's in Massachusetts is analyzed. Arguments are presented against single solutions, and emphasis is placed on the need for research on alternatives.

Pub. Dec. 71: 127p., NTIS No. PB-211 922: PC \$5.45 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0360, SOCIOLOGICAL IMPACT OF A FLOOD-CONTROL RESERVOIR

S.M. LEADLEY, Penn. State University, Inst. Res. Land & Wtr. Resour., University Park, Pennsylvania 16802

The social organization of a community adjacent to a newly constructed flood-control reservoir and four reservoir-based recreation areas is under pressure to change. This research has collected and analyzed data from 89 community leaders and their organizations, both public and private. This analysis attempts to relate ecological change to shifts in both individual perceptions and organizational structures and processes.

The project's second phase will estimate the adjustment of households to changes in occupational and recreational opportunities, identify the potential roles of community to its new environment and assess the feasibility of adaptive organizational programs based on membership resources.

Survey data from a 1970 household enumeration will be supplemented by data from studies completed in this community in 1937, 1949, and 1960. Time-series analysis of modes of household and organizational adjustment to environmental change is planned.

Recommendations will be made regarding procedures for reducing social costs of ecological adjustment. Assistance will be given to community organizations as they attempt to identify and perform roles in the community adjustment process.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Reh.

6.0361, EFFECT OF AGNES FLOODS ON ANNUAL SERIES IN PENNSYLVANIA

B.M. REICH, Penn. State University, Inst. Res. Land & Wtr. Resour., University Park, Pennsylvania 16802

of the 44 cases. The threshold was established in previous studies as the ratio between a 1,000-year flood and an average annual flood, equivalent to about a 5% chance of being exceeded by a worse flood once or more in the next 50 years. Most locations have high probabilities of being struck by far worse floods than they experienced in 1972.

Pub. Jul. 73: 80p., NTIS No. PB-231 871/5: PC \$7.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0362, FLOOD CONTROL STUDY OF RIO GRANDE DE MANATI, MANATI AND BARCELONETA, PUERTO RICO

UNKNOWN, State Planning Board, Santurce, Puerto Rico

Abstract: The report presents the results of a study to provide flood protection to areas within the Rio Grande de Manati watershed, so as to permit best reasonable use of lands subject to periodic flooding. This study provides information needed for the production of land use recommendations for definite areas subject to floods, but otherwise suitable for urban expansion.

Pub. Jan. 70: 262p., NTIS No. PB-196 488: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0363, MYRTLE BEACH, S.C. - COMPREHENSIVE DEVELOPMENT PLAN

UNKNOWN, State Planning & Grants Div., Columbia, South Carolina

Abstract: A comprehensive development plan containing data relative to the economy, population, goals, physical constraints, existing land use, future land use, and thoroughfares within the area defined as the Myrtle Beach Planning Area.

Pub. Apr. 70: 155p., NTIS No. PB-192 352: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0364, FLOOD PLAIN INUNDATION

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Columbia, South Carolina 29204

Because of damage from major floods, there is a great need for flood-plain zoning. Despite all precautionary measures available, damaging floods occur nearly every year in South Carolina. This project was initiated so as to show precisely the extent of area to be flooded during specific flood events.

The objective is to collect and analyze necessary data to determine stream slope and water surface profiles in those areas where flood damage of greatest magnitude is likely to occur.

The network includes a network of twenty-five crest-stage gages in major river basins. The network will be expanded each year by the addition of approximately twenty-five new stations until the network consists of about 100 stations. These stations, when operated until two or more floods of significant magnitude are experienced, would provide a reliable flood-water-surface slope in the basin reaches between the gages.

Installation of 17 crest-stage gages and collection of data from these stations.

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Columbia, South Carolina 29204

Prior to this project, there were no USGS gaging stations on small streams in drainage areas 1-40 square miles in South Carolina. This project was initiated because of the need for knowledge relative to magnitude and frequency of floods on small streams for design of highway drainage structures.

The objective is to collect and analyze necessary data and to develop relationships which can be used to determine the flood-frequency characteristics of any small stream in the state.

The project includes a network of 60 stations, each equipped with dual-digital recorders, located to give coverage of the state. The recorders measure stream stage and associated rainfall. The physical characteristics of each selected basin will be tabulated and the stage-discharge relation will be determined at each station. The data collection will involve about 30 flood events. These data will be used in conjunction with a digital computer model of the rainfall-runoff process to extend a record of flood peaks. The observed and computed data will be used to define the flood-frequency curve for each station.

Rainfall and stage data were collected during the year with most stations recording from one to six flood events. Most flood events of significant magnitude occurred during March, July and August. Twenty percent of the stations experienced an estimated 50-year flood.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0366, INVESTIGATION AND ANALYSIS OF FLOOD HYDROGRAPHS FROM SMALL DRAINAGE BASINS IN SOUTH DAKOTA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Huron, South Dakota 57350

The safest and most economical design of highway structures requires a knowledge of the magnitude and frequency of peak discharges that may be expected at any given site. Information concerning the characteristic shape of the flood hydrograph is also necessary. If storage is to be considered as a factor in the design of culverts in highway embankments.

To obtain an adequate measure of streamflow and basin characteristics which will provide an estimate of the magnitude and frequency of floods which might be expected from small drainage basins in South Dakota.

A total of 80 representative basins have been selected for study. Basin and streamflow characteristics will be determined for each basin. Continuous long-term precipitation records will be used to synthesize flood events and to extend peak flow records back in time. The optimum equations to compute flood peaks at the desired return intervals will be determined by using all data in a regression analysis.

Stage and precipitation data collection is continuing. Rating of stations and office review of data collected to date continued. Preliminary calibrations of the rainfall-runoff model were obtained for two stations. Results of these were quite encouraging.

Continue data collection program. Continue office review of data collected and computer analysis of data. Continue efforts toward model calibration.

The project will develop for the Tennessee River system comprehensive procedures which will allow current and consideration of all essential objectives, such as control, navigation, power production, water quality management, water supply, and recreation. These procedures increase TVA's capability to appraise system modifications and improve operation of the river and reservoir system.

Upon completion, the methods will become day-to-day tools for TVA's water resource planning and management activities. They will expand presently used decision processes by more comprehensive and automated procedures which can respond to the steadily increasing complex quantitative and qualitative water resource management and optimize the total benefit of the region's water resources.

The project is divided into three steps. Presently under investigation is Step 1, a case study, which assesses the effect of a flow requirement at a chosen site on quantity and economy parameters of the reservoir system. Study duration is one and a half years. This step is almost complete and three major reports describing methodology and results are in preparation. Presently under investigation is Step 2, which calls for analysis of methods and development of a comprehensive plan for system-wide implementation program. Step 2 duration is two years.

SUPPORTED BY U.S. Tennessee Valley Anth.

6.0368, BEECH RIVER WATERSHED PROJECT, TENNESSEE

C.H. SMITH, U.S. Tennessee Valley Anth., Knoxville, Tenn. see 37902

The Beech River Watershed Project established in 1953 is a demonstration of intensified development of land and water resources integrated with the development of other resources of the area comprising 193,200 acres in Henderson and Deatur Counties in the western part of Tennessee. The project is being carried on in cooperation with the Beech River Watershed Development Authority and State of Tennessee.

Hydrologic measurements began in 1953, to ascertain the effects on the water resources of the watershed and its tributaries resulting from changes in land cover, land-use, agriculture, and water management due to improvements in farming systems and the expansion and intensification of forestry programs. This included observations of precipitation, streamflow, both surface and ground water, suspended sediment to serve as a base in evaluating the effects on hydrologic characteristics of changes in land-use management.

The agricultural phase of the project is concerned with the improvement of land-use in sound farming systems.

The forestry phase is concerned with the expansion and intensification of forestry programs to increase both the timber base and the level of land resource utilization.

In December 1965 construction of a multipurpose water control system was completed for the Beech River watershed consisting of eight reservoirs and 71 miles of stream channel improvement. Hydrologic measurements are being continued to determine the hydraulic performance of the water control system, evaluate flood reductions, determine reservoir sedimentation and channel changes, and provide basic

Abstract: An ordinance is given establishing zoning districts--residential, commercial, industrial, and flood plain--within the town of Huntingdon, Tennessee, to relegate compatible uses of land to particular areas.

Pub. Oct. 70: 43p., NTIS No. PB-196 746: PC \$3.00 MF \$0.95.
SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0370, FLOODING OF SMALL STREAMS IN NASHVILLE-DAVIDSON COUNTY AREA, TENNESSEE

L.C. CONN. U.S. Dept. of the Interior, Geological Survey, Nashville, Tennessee 37203

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with State and local agencies in Tennessee.

Purpose: To determine the effect of urbanization on the volume, magnitude, frequency, and time of concentration of flood flows.

Methods: Hydrologic data presently available inside and outside of the county and additional data to be collected will be analyzed. Within a particular stream basin the following will be obtained: 1. Continuous streamflow and synchronized precipitation records at one site in the basin. 2. Continuous recordings of floodflow and concurrent storm precipitation at sites in selected sub-basins and at key points along the principal stream channels. 3. Supplementary surveys of high-water profiles between gaged sites following major flood events. 4. Channel cross-section and bed profile surveys necessary for flood-profile computations. 5. Compilation of necessary basin and urbanization parameters.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0371, INVESTIGATION OF THE MAGNITUDE AND FREQUENCY OF FLOODS ON SMALL STREAMS IN TENNESSEE

H.C. WILBEN, U.S. Dept. of the Interior, Geological Survey, Nashville, Tennessee 37203

Economic design of highway structures relies on sound evaluation of magnitude and frequency of floods. Data are not available to define adequately flood magnitude and frequency on small streams (less than 50 sq. Mi). Moreover, the number of small watersheds is so large that it will never be practical to gage more than a small percentage of them. There is a need to collect and analyze hydrologic data from selected small basins and to define therefrom flood-frequency relations applicable to the design of small-stream drainage structures.

This project is designed to provide data for estimating the magnitude and frequency of peak runoff from small ungaged watersheds. Its advantage over earlier projects with similar goals lies in providing a comparable product in less time.

The project will proceed through three phases: (1) Measure flood runoff and concurrent storm rainfall and compute various basin characteristics at 49 sites, to define the relationship between rainfall and peak flow by using the USGS hydrologic model. The gages will be operated 5-10 years, as required by each watershed; (2) Use the rainfall-peak flow relation and long-term rainfall record to synthesize a long-term flood-

to be surveyed. Rainfall-runoff model calibrations were made for seven stations. Initial results look good. Four stations were discontinued as it became apparent that we could not obtain a stable stage-discharge rating. Replacement sites are anticipated. Routine operation of the remaining gages continued. Long-term daily precipitation data for Nashville, Memphis, and Knoxville have been loaded onto the model file.

Routine data collection will be continued. Simulation of long-term peaks and computations of Log-Pearson frequency curves will begin. Nashville long-term until precipitation data will be picked off & loaded onto the model file. Long-term daily evaporation data will be picked & processed. (Text Abridged)

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0372, URBAN HYDROLOGY STUDY - AUSTIN, TEXAS

J.W. BOARD, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

Little data are available to determine the effect of urbanization on runoff. The collection of basic data in urban areas is necessary to provide for the most economic design of hydraulic structures and the delineation of flood-hazard areas.

Collect hydrologic data for studies to determine the effects of urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood-hazard areas; provide water-quality data for selected areas from water samples collected during runoff events which differ by season and magnitude.

Drainage basins with different hydrologic characteristics will be instrumented to collect simultaneous rainfall-runoff data. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events. Water-quality samples will be collected in selected areas to reflect the relation between water quality, season, and magnitude of peak.

Rainfall, runoff, and quality-water data were collected at all sites during the year. These data are being assembled into open-file annual basic-data reports.

Compilation and analysis of basic data will continue and annual basic-data reports will be published.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0373, URBAN HYDROLOGY STUDIES OF SELECTED AREAS IN TEXAS - DALLAS, AUSTIN

J.D. BOHN, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

Little data are available to determine the effect of urbanization on runoff. The collection of basic data in urban areas is necessary to provide for the most economical design of hydraulic structures and the delineation of flood hazard areas.

Collect hydrologic data for studies to determine the effects of urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood hazard areas; provide water-quality data for selected areas from water samples

by unusual flood events. Water-quality samples will be collected in selected areas to reflect the relation between water quality, season, and magnitude of peak.

Rainfall, runoff, and quality-water data were collected at all sites during the year. These data are being assembled into open-file annual basic data reports. A study is currently underway to analyze 5 years of peak data from 28 gaged drainage basins in the Houston metropolitan area. A peak discharge multiple regression prediction equation has been obtained for each basin using independent variables, precipitation duration, and an index of soil moisture. Prediction equations for the 28 gaged drainage basins had a standard error of estimate of 9 to 63 percent, with the average being 29 percent. Sixty years of local rainfall data have been applied to each of the prediction equations to obtain 60 years of peak-flow data. The peak-flow data have been related to various basin parameters to determine their effect on the magnitude of peak. Preliminary results show a range in standard error of estimate of 15 to 25 percent.

Compilation and analysis of basic data will continue and annual basic data reports will be published. Special studies in two metropolitan areas (Dallas and Austin) will be made to quantify the effects of urbanization on flood peaks and volumes.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0374, EFFECTS OF URBANIZATION ON FLOODS IN THE DALLAS, TEXAS METROPOLITAN AREA

G.R. DEMPSTER, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

Abstract: The effects of urbanization on flood characteristics of streams in the Dallas metropolitan area were studied by use of a digital model of the hydrologic system, which was calibrated by using observed data from 19 storms in six basins to estimate peak discharges and flood volumes and to simulate a 57-year record of annual peak discharges in 14 basins. The flood-frequency characteristics were defined by fitting the simulated 57-year record to a Log-Pearson Type III distribution. The data indicate that in a fully developed residential area, with a 37 percent impervious area, the average annual direct runoff is about double that of an undeveloped area.

Pub. Jan. 74: 57p., NTIS No. PB-230 188/5: PC \$3.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0375, HYDROLOGIC STUDIES OF SMALL RURAL TEXAS WATERSHEDS

V.H. GOINES, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with the State of Texas and the Soil Conservation Service.

Purpose: To determine the effects of temporary storage in small flood-detention structures, and of land-treatment measures on the water yield to major water-conservation reservoirs and to provide data which can be utilized in the design of future structures, and in checking the performance of existing structures.

Methods: Rainfall and runoff records are being collected at 4

adjacent basins will be used as currently being collected in the small watersheds. In basins where no flood-control structures have been built, detailed hydrologic data are available for several years, and by continuing the data collection program, the analysis before and after control development will be facilitated.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0376, EFFECTS OF URBANIZATION ON FLOODS IN THE HOUSTON, TEXAS METROPOLITAN AREA

S.L. JOHNSON, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

Abstract: Rainfall and runoff data from drainage basins in the Houston metropolitan area and a 60-year rainfall record from the National Weather Service Station, Houston-Clear Lake, are used to simulate 60 annual flood peaks at 26 sites. Frequency characteristics, based on these simulated peaks, are related to drainage area and percentage impervious area. These relations, which may be used to estimate the flood characteristics at ungaged sites, indicate that in the Houston metropolitan area, complete urbanization increases the magnitude of a 2-year flood nine times and increases the magnitude of a 50-year flood five times.

Pub. Apr. 73: 56p., NTIS No. PB-220 751/2: PC \$3.75 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0377, URBAN HYDROLOGY STUDY - SAN ANTONIO, TEXAS

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with the State of Texas.

Purpose: To provide data for a logical approach to flood-control and flood-protection problems, and to analyze the effects of progressive urbanization on the runoff. Data will also be useful in design of storm sewers, culverts, and bridges.

Methods: An adequate sampling will be made of runoff with respect to flood discharge as affected by time, variation in rainfall through climatic cycles, size of area, and degree of urbanization of area. This sampling will be accomplished by installation of streamflow stations, crest-stage stations, and rain gages at appropriate locations. The instrumented basins will be done on pairs of small drainage basins within the metropolitan area. One basin of a pair will be developed to represent urbanized conditions; the other will represent undeveloped conditions. Insofar as possible, the basins will be chosen so that the other factors such as geology, topography, and size will be equal.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0378, TECHNIQUE FOR PROJECTING ALTERNATIVE FUTURES FOR WATER RESOURCE PLANNING

L.R. BEARD, Univ. of Texas, Ctr. Res. in Water Resources, Austin, Texas 78712 (C-5340-X)

The occurrence of unexpected trends and events in water resources variables has seriously impacted on the success of the projects. To the extent that these are unpredictable, alternative possible projections must be developed.

teristics of that variable. A number of variables where extensive data on past trends are available will be chosen for special study. A large number of records for each of these variables will be studied to determine trend functions, stochastic characteristics and the nature and frequency of extreme events that do not conform to the mathematical functions employed. Mathematical models will be developed for generating representative sets of projections. Means will be devised for incorporating unexpected departures from mathematical functions in projections to the extent that these are observed in records of the phenomenon. Each projection in a set will represent a specified proportion of all future possibilities.

As a special activity under this project, studies will be made to formulate comprehensive procedures that can be used in virtually all regions by all agencies for estimating flood peak flow probabilities with a relatively high degree of reliability and uniformity. The resulting technical manual is intended to fill a critical technology gap until such time as a more comprehensive flood frequency research and development project is possible.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

6.0379. WATER FOR TEXAS - URBAN WATER RESOURCES PLANNING AND MANAGEMENT - THE PROCEEDINGS OF THE ANNUAL CONFERENCE HELD AT SAN ANTONIO (ABBREV)

UNKNOWN, Texas A & M University System, Water Resources Institute, College Station, Texas 77843

Abstract: The theme of the 16th Annual Conference on Water for Texas was urban water resources planning and management. Among the topics discussed are: perspectives in urban water management, systems description for urban water resources, conjunctive use of surface and ground water in urban water supplies, hydrometeorology for urban runoff systems, flood plain planning in urban areas, socio-economic aspects of urban water planning, environmental enhancement and recreation, costs of water reuse, river basin quality simulation, Bureau of Reclamation programs related to urban water resources and comprehensive inter-basin planning and inter-governmental coordination. Most papers use examples in Texas, especially the San Antonio area.

Pub. Sep. 71: 182., NTIS No. PB-210 325: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0380. OSO CREEK TECHNICAL ASSISTANCE STUDY - PRELIMINARY STUDY ON THE PROBLEMS AND OPPORTUNITIES FOR DEVELOPMENT OF OSO CREEK AND OSO BAY

UNKNOWN, U.S. Coastal Bend Reg. Comm., Corpus Christi, Texas

Abstract: There are many factors which should influence any plan for development of Oso Creek. Flood control measures may be proposed for the Oso by the Corps of Engineers, Nueces County Drainage District No. 2, and the Nueces County Development Group. When agreement is reached concerning coordination of flood prevention and control for the upper Oso, then consideration must be given to the development plans for the entire Oso Creek basin. Existing and potential urban-industrial, extractive and agricultural economies must be identified and dealt with in a manner

Creek will play in the development of Nueces County and the Region.

Pub. Mar. 71: 13p., NTIS No. PB-201 213: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0381. SOIL AND WATER CONSERVATION NEEDS INVENTORY, COOKE, GRAYSON AND FANNIN COUNTIES, TEXAS

UNKNOWN, Texoma Regional Planning Comm., Denison, Texas 75020

Abstract: The inventory includes basic data that show the kind of soil, slope, erosion and land use characteristics in Cooke, Grayson and Fannin Counties. The land use classifications are separated into cropland, pastureland, rangeland, forest and woodland and 'other'. The acreages needing treatment in the various classification are described and the treatment that is feasible for this particular soil deficiency is outlined. Forest and woodlands needing establishment, improvement, protection or windbreaks are also described. All watersheds are delineated showing the problems with flooding and conservation of water along with project actions required to solve these problems.

Pub. Aug. 70: 57., NTIS No. PB-195 447: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0382. URBAN HYDROLOGY STUDY, DALLAS, TEXAS

G.R. DEMPSTER, U.S. Dept. of the Interior, Geological Survey, Fort Worth, Texas 76115

Purpose: To define in Five Mile, Cedar, and Coombs Creek watersheds which would be inundated by past floods of defined frequency. To collect basic hydrologic data on floods of greater-than-ordinary magnitude in these watersheds and White Rock, Barkman, and Joes watersheds. To determine the effects of urban development on flood flows and total runoff in the White Rock Creek area.

Methods: The three major objectives of this project are interrelated to the extent that all hydrologic data collected will be applicable to each objective. Hydrologic instruments and surveys associated with the long-range program will provide the necessary data to define areas inundated by specific floods and to evaluate the effects of urban development on runoff. The data, analyses and computation associated with the short-term phase of the project to provide interpretive information on areas which would be inundated by floods of selected frequency will be applicable to the other objectives and would be strengthened and substantiated by data collected on floods experienced in the watershed. The data collected on the partly urbanized White Rock Creek watershed will be integrated with that being collected on the adjoining but mostly urbanized Barkman Branch and Joes Creek watersheds and the completely urbanized Turtle Creek watershed for analysis.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0383. URBAN HYDROLOGY STUDY - FORT WORTH, TEXAS

B.B. HAMPTON, U.S. Dept. of the Interior, Geological Survey, Fort Worth, Texas 76115

6 0384.

Collect hydrologic data for studies to determine the effects of urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood-hazard areas.

Drainage basins with different hydrologic characteristics will be instrumented to collect simultaneous rainfall-runoff data. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events.

Rainfall, runoff, and water-quality data were collected at all sites during the year.

Compilation and analysis of basic data will continue, and annual basic-data reports will be prepared.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0384. URBAN HYDROLOGY STUDY - DALLAS COUNTY, TEXAS

B.C. MASSEY, U.S. Dept. of the Interior, Geological Survey, Fort Worth, Texas 76115

Little data are available to determine the effect of urbanization on runoff. The collection of basic data in urban areas is necessary to provide for the most economic design of hydraulic structures and the delineation of flood-hazard areas.

Collect hydrologic data for studies to determine the effects of urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood-hazard areas.

Drainage basins with different hydrologic characteristics will be instrumented to collect simultaneous rainfall-runoff data. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events.

The effects of urbanization of flood characteristics of streams in the Dallas metropolitan area were studied by use of a digital model of the hydrologic system, which was calibrated by using observed data from 19 storms in six basins to estimate peak discharges and flood volumes and to simulate a 57-year record of annual peak discharges in 14 basins. The flood-frequency characteristics were defined by fitting the simulated 57-year record to a Log-Pearson Type III distribution.

The project will be reviewed, some rain gages will be deleted and some relocated. Emphasis will be placed on collecting data from small watersheds.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0385. PALACIOS COMPREHENSIVE PLAN - PHASE 2 - SUMMARY REPORT

G.L. WILLIAMS, Lockwood Andrews & Newman Inc., Houston, Texas

Abstract: The report summarizes the second phase of the Comprehensive Plan for Palacios, Texas. The goals and objectives determined in the first phase were re-evaluated to establish appropriate guidelines for the basic planning recommendations. The planning period was projected to 1992.

Pub. Apr. 72: 106p., NTIS No. PB-213 189/4. PC \$7.50 MF \$0.95

Little data are available to determine the effect of urbanization on runoff and quality of water in gentle sloping areas. The collection of basic data in urban areas of Palacios is necessary to provide for the most economic design of hydraulic structures and the delineation of flood-hazard areas.

Collect hydrologic data for studies to determine the effects of urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood-hazard areas. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events.

Drainage basins with different hydrologic characteristics will be instrumented to collect simultaneous rainfall-runoff data. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events. Water-quality samples will be collected in selected areas to reflect the relation between runoff, season, and magnitude of peak.

Rainfall and runoff data from drainage basins in the Dallas Metropolitan Area and a 60-year rainfall record from the National Weather Service Station, Houston City, will be used to simulate 60-annual flood peaks at 26 sites. Selectivity characteristics, based on these simulated annual peaks, related to drainage area and percentage of imperviousness. These relations, which may be used to estimate flood characteristics at ungaged sites, indicate that in the Dallas Metropolitan Area, complete urbanization increases the magnitude of a 2-year flood nine times and increases the magnitude of a 50-year flood five times.

The projected data collection instrumentation will be completed and an attempt made to collect data which can be used in a rainfall-runoff model.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0387. VARIATION OF URBAN RUNOFF WITH INTENSITY OF STORMS - TEXAS

D.M. WELLS, Texas Technological University, Lubbock, Texas 79409

Abstract: A simulation model describes the quantitative regimes of storm water runoff from watersheds. The urban runoff system consists of three subsystems: Precipitation, runoff, and quality. Each subsystem is mathematically modeled using probability and statistical techniques. Major flooding in the State of Texas is associated with short-duration high-intensity convective storms. The model assumes these short-duration precipitation events are random and governed by a probability distribution function. A bivariate log-normal distribution function fits the observed rainfall depths for Lubbock, Texas. The runoff process is modeled using the British Road Research Laboratory method, which assumes that all runoff is derived from interconnecting areas. Rainfall inputs are simulated by the Monte Carlo method. The outflow hydrograph is generated by the reservoir routing. The total pollutant load is predicted by multiple regression involving the storm characteristics and the antecedent conditions.

Pub. Aug. 71: 161p., NTIS No. PB-204 235. PC \$7.50 MF \$0.95.

Objective: Determine water yield and rates and amounts of storm runoff from agricultural watersheds as affected by: climatic factors, watershed size, land use and treatment, cover conditions, and soils and geology. Develop methods of estimating water yield and storm runoff from ungauged areas, and routing these flows in larger watersheds.

Approach: In the Edwards Plateau near Sonora, runoff will be measured at 5 flood detention reservoirs and one gauging station, with drainage areas of 686 to 30,720 acres. Supplemental information regarding cover, geology, soils and ground water conditions, also available, will improve the accuracy of prediction of storm runoff and water yield from ungauged areas.

Progress: Rainfall and runoff data for 1968 have been obtained at five floodwater detention structures, and seven non source watersheds. Annual rainfall was near normal with two storm periods, April 9 and May 8-10, that caused appreciable runoff. Rainfall for April 9 ranged from 3.55 to 4.68 inches and runoff from none to 0.32 inch at Site 12 with 2,801 acres drainage area and 0.34 inch from Site 13 with drainage area of 686 acres. For the May storm period, runoff was from none at any sites to 0.41 inch at Site 12. Apparently dense growth of broomweed on the deep upland soils caused less than average runoff from the near normal rainfall. From the seven years record, decreased runoff with increased size of drainage area is indicated.

SUPPORTED BY Texas State Government - Austin

6.0389, URBAN HYDROLOGY STUDY, SAN ANTONIO, TEXAS

R.D. STEGER, U.S. Dept. of the Interior, Geological Survey, San Antonio, Texas

Little data are available to determine the effect of urbanization on runoff. The collection of basic data in urban areas is necessary to provide for the most economic design of hydraulic structures and the delineation of flood-hazard areas.

Collect hydrologic data for studies to determine the effects of urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage areas; delineate actual floods to determine flood-hazard areas; provide water-quality data for selected areas from water samples collected during runoff events which differ by season and magnitude.

Drainage basins with different hydrologic characteristics will be instrumented to collect simultaneous rainfall-runoff data. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events. Water-quality samples will be collected in selected areas to reflect the relation between water quality, season, and magnitude of peak.

Rainfall, runoff, and quality-water data were collected at all sites during the year. These data are being assembled into open-file annual basic-data reports.

Compilation and analysis of basic data will continue and annual basic-data reports will be published.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0390, DEFINING THE ELEMENTS OF THE SOCIOLOGICAL SYSTEM RELATED TO DRAINAGE PROBLEMS

social factors, the objectives included description and measurement of attitudes, needs and actions related to the decision problem as well as analysis of certain institutional constraints or organizational problems of government agencies affecting the drainage decision process.

Social factors identified related to several areas including flooding experience, awareness and information, level of concern, attitudes about flood management, attitudes toward and knowledge about specific proposals, social participation, aesthetic, leisure and environmental measures and demographic characteristics.

The survey found that home ownership, location of residence, length of residence, higher education and male sex were factors associated with higher awareness.

This work was done as a forerunner to other work dealing with this decision process. The variables identified here are being analyzed further for use in model development.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0391, FLASH FLOOD FORECASTING AND WARNING PROGRAM IN THE WESTERN REGION

P. WILLIAMS, U.S. Dept. of Commerce, Natl. Weather Service, Salt Lake City, Utah

Abstract: After describing the major characteristics of flash flooding in the Western Region of the United States, information is given on the requirements for effective warning and preparedness programs. There follows an informative presentation of the procedures involved in the forecasting of flash floods. Special attention is given to precipitation associated with cut-off upper lows. Such precipitation can be sufficiently heavy to result in flash flooding over the Intermountain Region.

Pub. Dec. 72: 18p., NTIS No. COM-73-10251: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0392, MAGNITUDE AND FREQUENCY OF FLOODS IN UTAH

F.K. FIELDS, U.S. Dept. of the Interior, Geological Survey, Salt Lake City, Utah 84111

The methods currently available to estimate flood frequency characteristics at ungaged sites are inadequate for refined hydraulic design.

To provide improved methods of estimating flood discharges for selected recurrence intervals.

About 70 crest gages will be operated in conjunction with the existing streamflow gaging station network to provide an expanded data base. Meaningful expressions of basin characteristics, significant relative to flood flows, will be sought. Predictive equations will be defined by multiple regression. The expanded data base and basin parameters should yield predictive equations of increased reliability.

The variance of topographic relief map and channel geometry parameters were found to be significantly related to selected recurrence interval floods. About 200 flood peaks on ephemeral streams were selected and tabulated for various statistical analyses.

A multiple-regression analysis of flood-peak data collected prior to October 1973, will be made. This analysis will test various climatic and physiographic parameters for incorpora-

urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood-hazard areas.

Drainage basins with different hydrologic characteristics will be instrumented to collect simultaneous rainfall-runoff data. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events.

Rainfall, runoff, and water-quality data were collected at all sites during the year.

Compilation and analysis of basic data will continue, and annual basic-data reports will be prepared.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0384, URBAN HYDROLOGY STUDY - DALLAS COUNTY, TEXAS

B.C. MASSEY, U.S. Dept. of the Interior, Geological Survey, Fort Worth, Texas 76115

Little data are available to determine the effect of urbanization on runoff. The collection of basic data in urban areas is necessary to provide for the most economic design of hydraulic structures and the delineation of flood-hazard areas.

Collect hydrologic data for studies to determine the effects of urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood-hazard areas.

Drainage basins with different hydrologic characteristics will be instrumented to collect simultaneous rainfall-runoff data. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events.

The effects of urbanization of flood characteristics of streams in the Dallas metropolitan area were studied by use of a digital model of the hydrologic system, which was calibrated by using observed data from 19 storms in six basins to estimate peak discharges and flood volumes and to simulate a 57-year record of annual peak discharges in 14 basins. The flood-frequency characteristics were defined by fitting the simulated 57-year record to a Log-Pearson Type III distribution.

The project will be reviewed, some rain gages will be deleted and some relocated. Emphasis will be placed on collecting data from small watersheds.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0385, PALACIOS COMPREHENSIVE PLAN - PHASE 2 - SUMMARY REPORT

G.L. WILLIAMS, Lackwood Andrews & Newman Inc., Houston, Texas

Abstract: The report summarizes the second phase of the Comprehensive Plan for Palacios, Texas. The goals and objectives determined in the first phase were re-evaluated to establish appropriate guidelines for the basic planning recommendations. The planning period was projected to 1992.

Pub. Apr. 72: 106p., NTIS No. PB-213 189/4: PC \$7.50 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

6.0386, URBAN HYDROLOGY STUDY - HOUSTON, TEXAS

urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood-hazard areas.

Collect hydrologic data for studies to determine the effects of urbanization on flood discharge and total runoff with variation in rainfall patterns, rainfall intensity, and drainage area; delineate actual floods to determine flood-hazard areas. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events. Water-quality samples will be collected during runoff events which differ in magnitude.

Drainage basins with different hydrologic characteristics will be instrumented to collect simultaneous rainfall-runoff data. Flood-profile data will be collected in requested stream reaches. Field surveys will be run to determine areas flooded by unusual flood events. Water-quality samples will be collected in selected areas to reflect the relation between runoff, season, and magnitude of peak.

Rainfall and runoff data from drainage basins in the Metropolitan Area and a 60-year rainfall record from the National Weather Service Station, Houston City Station, will be used to simulate 60-annual flood peaks at 26 sites. Study characteristics, based on these simulated peaks, related to drainage area and percentage of impervious area. These relations, which may be used to estimate flood characteristics at ungaged sites, indicate that the Metropolitan Area, complete urbanization increases the magnitude of a 2-year flood nine times and increases the magnitude of a 50-year flood five times.

The projected data collection instrumentation will be used and an attempt made to collect data which can be readily used in a rainfall-runoff model.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0387, VARIATION OF URBAN RUNOFF CHARACTERISTICS WITH INTENSITY OF STORMS - TEXAS

D.M. WELLS, Texas Technological University, Lubbock, Texas 79409

Abstract: A simulation model describes the qualitative regimes of storm water runoff from watersheds. The urban runoff system consists of three subsystems: Precipitation, runoff, and quality. Each subsystem is mathematically modeled using empirical and statistical techniques. Major flooding in the Metropolitan Area of Texas is associated with short-duration high-intensity convective storms. The model assumes these storms are random and governed by a probability distribution function. A bivariate probability distribution function fits the observed rainfall data for Lubbock, Texas. The runoff process is modeled using the British Road Research Laboratory method. The outflow hydrograph is generated by routing the runoff through a reservoir routing. The total pollutant load is determined by multiple regression involving the storm characteristics and the antecedent conditions.

Pub. Aug. 71: 161p., NTIS No. PB-204 235: PC \$7.50 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0388, RELATION OF CLIMATIC AND TOPOGRAPHIC CHARACTERISTICS TO STORM RUNOFF PATTERNS - PLATEAU, TEXAS

Objective: Determine water yield and rates and amounts of storm runoff from agricultural watersheds as affected by: climatic factors, watershed size, land use and treatment, cover conditions, and soils and geology. Develop methods of estimating water yield and storm runoff from ungauged areas, and routing these flows in larger watersheds.

Approach: In the Edwards Plateau near Sonora, runoff will be measured at 5 flood detention reservoirs and one gauging station, with drainage areas of 686 to 30,720 acres. Supplemental information regarding cover, geology, soils and ground water conditions, also available, will improve the accuracy of prediction of storm runoff and water yield from ungauged areas.

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SUPPORTED BY Texas State Government - Austin

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Compilation and analysis of basic data will continue and annual basic-data reports will be published.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

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social factors, the objectives included description and measurement of attitudes, needs and actions related to the decision problem as well as analysis of certain institutional constraints or organizational problems of government agencies affecting the drainage decision process.

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This work was done as a forerunner to other work dealing with this decision process. The variables identified here are being analyzed further for use in model development.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0391, FLASH FLOOD FORECASTING AND WARNING PROGRAM IN THE WESTERN REGION

P. WILLIAMS, U.S. Dept. of Commerce, Natl. Weather Service, Salt Lake City, Utah

Abstract: After describing the major characteristics of flash flooding in the Western Region of the United States, information is given on the requirements for effective warning and preparedness programs. There follows an informative presentation of the procedures involved in the forecasting of flash floods. Special attention is given to precipitation associated with cut-off upper lows. Such precipitation can be sufficiently heavy to result in flash flooding over the Intermountain Region.

Pub. Dec. 72: 18p., NTIS No. COM-73-10251: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

6.0392, MAGNITUDE AND FREQUENCY OF FLOODS IN UTAH

F.K. FIELDS, U.S. Dept. of the Interior, Geological Survey, Salt Lake City, Utah 84111

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A multiple-regression analysis of flood-peak data collected prior to October 1973, will be made. This analysis will test various climatic and physiographic parameters for incorporation

A.O. LIND, Univ. of Vermont, School of Arts, Burlington, Vermont 05401

Abstract. The author has identified the following significant results. ERTS-I imagery showing seasonal lake-level conditions in Lake Champlain can be used to assess shoreline change and flooding extent. MSS bands 6 and 7 provide maximum land-water contrasts and are the most useful for shoreline location. Shoreline changes observed between ERTS coverages of October 10 (low water) and April 7 and 25 (high water) and readily apparent and enlargement of specific scenes by a factor of four provides data which can be transferred to a map base. The unique synoptic view provided by ERTS-I will make it possible to map shoreline positions occurring at a specific lake stage. Due to present government concerns over abnormally high lake levels, resource management questions have been raised regarding the extent, nature, and occurrence of inundation magnitude of shoreline change, and lake volume change.

Pub. Jun. 73: 11p., NTIS No E-73-10771: PC \$3.00 MF \$1.45
SUPPORTED BY U.S. Natl. Aero. & Space Adm.

6.0394. TECHNIQUES OF FLOOD-PLAIN MAPPING FOR LAND-USE MANAGEMENT OF FLOOD PLAINS

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Arlington, Virginia 22209

Identification of lands subject to flooding is necessary for land-use management on flood plains. Accurate delineation on maps, of areas subject to inundation by floods of a given frequency is required; information on frequency of flood discharges, profiles of water-surface elevations along the channel, and large-scale topographic maps. Information obtained during field surveys is needed for computing water-surface profiles by step-backwater procedures. New techniques of photogrammetry, electronic measurement from aircraft, computation of backwater profiles, and the plotting of maps and cross sections by computer may offer more efficient means of flood-plain delineation.

To evaluate potential flood-mapping techniques, appraise their accuracy in relation to cost for various uses and time frame in which flood-plain maps are of maximum use, and to investigate means to carry out flood-mapping techniques at an accelerated rate.

Investigate and compare available methods of obtaining data required for preparing maps, charts, and interpretive reports associated with identification of flood-prone areas. Determine the range in costs involved in the conventional aerial photography-steren model approach of obtaining measurements of valley cross sections. Investigate the potential of the laser altimeter in its application to aerial surveying, and the possibility of direct survey from the air without going through the stereo-model plotting process.

A pilot study was made in cooperation with the Topographic Division, USGS, to evaluate potential flood-mapping techniques using photogrammetry. Photography taken at 6,000 feet provided the best resolution. In vertical accuracy tests, 68 percent of the points were within 0.5 foot and 95 percent were within 0.9 foot of correct elevation. A flood-hazard map of Jackson, Mo., was prepared in accordance with requirements of the Department of Housing and Urban Development (HUD) in the flood insurance program.

Expand initial approach of investigations. Analyze accuracy-cost factors of flood-plain mapping from experience to date.

SUPPORTED BY U.S. Dept. of Interior - Geological

6.0395. SEDIMENT MOVEMENT AND MORPHOLOGY IN THE CENTRAL APPALACHIAN - VIRGINIA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Arlington, Virginia 22209

Sediment, particularly in connection with major rain floods, causes many deaths and millions of dollars damage annually. The destruction results from sedimentation, its movement down hillsides and along stream channels, and its deposition. The prediction of important sediment events and the prevention or reduction of damage cannot be possible until systematic, planned sedimentation and geomorphic studies are made.

To derive a basis for predicting the occurrence and magnitude of major sediment movements on hillslopes and in the Central Appalachians and nearby areas, it is necessary to prevent or reduce the customary widespread damage caused by sedimentation to man and his property from such movements.

Document and examine the geomorphic and sedimentary features of catastrophic sediment movements such as those which resulted in central Virginia from the rains of 1969. Measure and evaluate the extent of erosion, the amount and location of deposition of sediment particles involved, geomorphic characteristics of affected and unaffected hillslopes and valleys, and other features which may aid in attaining the research objectives.

Obtain further field data on channel geometry and sediment material samples. Continue analyzing data on channel geometry. Write further portions of first draft of report on same. Results to date show some promise of establishing relationship between flow characteristics at a station and measurable features of the channel, such as channel cross-section and sizes of bed material.

Complete the analysis of the data on hand; obtain additional data as the need arises; draw conclusions; finish first draft of manuscript.

SUPPORTED BY U.S. Dept. of Interior - Geological

6.0396. NUMERICAL STUDIES OF UNSTEADY FLOW IN THE JAMES RIVER - VIRGINIA

D.N. CONTRACTOR, Virginia Polytechnic Institute, Blacksburg, Virginia 24061

Abstract: The implicit method of solution of the continuity and momentum equations of flow in open channels was used to study problems of unsteady flow in natural river channels. A computer program was written to obtain solutions also with appropriate boundary conditions. The first problem relates to flood flows in the James River. A storm in 1967 was analyzed and the comparison between predicted and measured flows was good. The second problem relates to the study of low flows from Holcomb's Dam in Virginia to Bent Creek, Virginia in the James River. A model of these flows showed that the program in steady state was unstable. However, when the same program was run in double precision, good agreements were obtained between measured and computed flows. The last problem relates to analysis of waves in a pump-storage reservoir. Data were obtained on flows in Leesville Reservoir, on the Roanoke River, Virginia.

Pub. Sep. 71: 54p., NTIS No E-71-206, PC \$3.00 MF \$1.45

1.A. SHABMAN, Virginia Polytechnic Institute, School of Agriculture, Blacksburg, Virginia 24061

The factors influencing the adoption of flood plain regulations within Virginia will be identified. Particular concern will be paid to the way the choice process for these regulations affects, and is affected by, the distribution of economic gains and losses. Analytical steps will include: (1) Survey existing flood plain regulations in Virginia and categorize such policies according to type and socio-economic and physical factors associated with their adoption; (2) Develop tools for analyzing the economic effect of alternative land use controls in the flood plain. These tools will be grounded in relevant economic theory and incorporated in a model adaptable to computerized simulation; (3) Analyze the economic impact of a given number of flood plain regulations for case studies selected from insights gained through Step 1, above; (4) Evaluate the relationship between the economic result and the political choice process for each case study; (5) Develop a series of recommendations for encouraging more effective use of flood plain regulations within Virginia

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0398, FLOOD DAMAGE ABATEMENT: FEDERAL ASSISTANCE TO LOCAL GOVERNMENT

B.R. WALKER, Virginia Polytechnic Institute, Water Resources Research Ctr., Blacksburg, Virginia 24061

Abstract: Contents: Opportunities and responsibilities of local government; Land use management an economic necessity; Flood plain information reports - what they are and how they are used; Engineering data for sound land use planning; Flood plain information studies applied to local condition; Open space program-opportunity in land use management; Comprehensive flood plain development with TVA; U.S. Geological Survey flood-mapping programs; Fairfax County cooperates; Flood plain management in Wisconsin-a local-state effort; Federal, state, and local cooperation in recreation and flood plain development; Soil Conservation Service programs in urban and rural development.

Pub. Jnl. 70: 147p., NUIS No. PB-195 425: HC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel.

6.0399, FLOOD DAMAGE ABATEMENT STUDY FOR VIRGINIA

B.R. WALKER, Virginia Polytechnic Institute, Water Resources Research Ctr., Blacksburg, Virginia 24061

Abstract: The study gives a quick review of the national flood problem, a comprehensive review of the problem in Virginia, an identification of various programs which have attempted to ameliorate flood damages, and two major pieces of legislation recommended to be adopted for further progress in flood damage abatement. Floods are too big a problem to be handled piecemeal. Only when we shift from simply reacting to them to actually planning for them can we expect to make headway in reducing flood damage losses. Flood plain occupation in which benefits do not exceed the estimated total costs (direct, indirect, and social) is undesirable, because it causes an eventual net loss to society. Any public policy encouraging submarginal development adds to those losses. Vir-

6.0400, URBAN HYDROLOGY OF STREAMS IN FAIRFAX COUNTY

P.L. SOULE, U.S. Dept. of the Interior, Geological Survey, Fairfax, Virginia

Fairfax County is in a period of very rapid suburban and urban development. Much of the county is still rural and there is negligible encroachment onto the flood plains. County officials desire to protect its citizens and industry from flood disasters by regulating encroachment onto the flood hazard areas which are to be delineated as a part of this project. Urbanization is believed to increase the flood peak magnitudes; therefore, the effects of the ultimate urbanization must be considered when the zones of flood hazard are delineated.

To compute flood profiles for floods having recurrence intervals of 25-, 50-, and 100-years and to delineate the areas inundated on large scale topographic maps.

Data collected and analytical studies to be made on effects of urbanization upon floods in that area of the Piedmont physiographic province within 50 miles of Washington, D.C. Regression analysis is used to establish values to certain parameters in equations for computing discharge at any given point for a given recurrence interval flood under conditions of ultimate development. Discharges computed to be utilized in step backwater computations to compute flood profiles. Flood profiles to be used to delineate areas inundated on topographic maps, scale 1" equals 100'.

Final delineation was completed for Giles Run, Little Rocky Run, Elk Horn Run, Wolf Run, Sandy Run, and Pope's Head Creek basins; 59 maps were released to the open file.

Flood plain delineation will be completed for Fairfax County. Project report written.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0401, URBAN FLOOD HYDROLOGY OF STREAMS IN FAIRFAX COUNTY, VIRGINIA

F.P. KAPINOS, U.S. Dept. of the Interior, Geological Survey, Richmond, Virginia 23220

This research is part of the program of water resources investigations conducted by the U. S. Geological Survey in cooperation with state and local agencies in Virginia.

Purpose: To delineate flood hazard areas and provide flood information for use in county regulation of these areas in order to protect citizens and industry from flood disasters.

Methods: Existing literature has been reviewed, a hydrologic data collection program established, and available data reduced. Basin parameters (drainage area, stream length, stream slope, lag time, percent basin imperviousness and classification of drainage systems) have been determined. Regression techniques were used to derive an empirical equation for lag time as a function of various length-slope parameters. Primary effects of urbanization have been evaluated.

Flood profile elevations are computed using the standard-step method of backwater computation. The water-surface profile elevations are used to delineate the extent of the flood-hazard areas.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0402, PILOT STUDY OF FLOOD PLAIN MANAGE-

structed to demonstrate how flood damages occur and various means of reducing them. A motion picture film has been prepared for public viewing to illustrate this and brochures are being prepared.

A State-wide survey of potential flood problems has been conducted of all counties and municipalities of more than 500 population. Flood damage reduction planning programs are in progress in several counties which are being assisted and monitored by the principal investigators. Short courses and workshops have been conducted throughout the State for planners, engineers, and governmental leaders.

Because of the impacts that floods create on public health and welfare, this program will continue both in research and extension activities.

SUPPORTED BY Washington State Government - Olympia

6.0403. FLOOD PROFILES AND INUNDATED AREAS ALONG THE LOWER NISQUALLY RIVER, WASHINGTON

J.E. CUMMANS, U.S. Dept. of the Interior, Geological Survey, Tacoma, Washington 98402

Abstract: Nisqually River flood profiles, covering the reach from near the river mouth to river mile 6.4, indicate that the main channel will convey without overflow discharges as large as about 21,000 cubic feet per second; this discharge has a 6-year recurrence interval. The banks in some areas will be overtopped at 25,500 cubic feet per second, which has a 13-year recurrence interval. Determined for six flood-profile stations were areas where overbank flooding first occurs and water-surface profiles of 3.4-year and 100-year floods. Alder and La Grande Reservoirs can reduce the magnitude of lower annual flood peaks downstream to some extent, but insufficient data are available to allow prediction of their effects on very large floods.

Pub. Oct. 73: 17p., NTIS No. PB-230 026/7; PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0404. FLOOD PROFILES AND INUNDATED AREAS ALONG THE SKOKOMISH RIVER, WASHINGTON

J.E. CUMMANS, U.S. Dept. of the Interior, Geological Survey, Tacoma, Washington 98402

Abstract: Flood profiles covering the main stem Skokomish River and reaches of the South and North Forks of the Skokomish River and Vance Creek were developed. The main-stem channel of the Skokomish River will contain flows only as large as 4,650 cubic feet per second downstream from U.S. Highway 101, and the flood plain in this reach is subject to inundation on an average of about 10 days each year. The main-stem channel between U.S. Highway 101 and the junction of the North and South Forks will contain flows as large as 8,900 cubic feet per second; such flows occur nearly every year, and have recurred at least six times during one flood season. Flooding is minimal on the three main tributaries above their confluence at river mile 9.0. Storage and diversion of Cushman Dam No. 2 significantly reduces the magnitude of floods of the North Fork Skokomish River. On the main stem, 50- and 100-year floods are predicted.

Pub. Dec. 73: 24p., NTIS No. PB-231 765/9; PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0405. FLOOD HAZARD INFORMATION - BUFFALO

This report describes the flood potential in Logan County, West Virginia, as it had in the disaster of 26 February 1972. The report contains information and data compiled previously from topographic and other data compiled from several iterations resulting from the intense flooding.

Contained in the report are profiles and maps showing the extent and magnitude of probable flooding of Buffalo Creek from its mouth upstream to Middle Fork, a distance of about 16 miles. The profiles, based on post-disaster channel conditions, show, to the extent possible, the emergency debris removal work undertaken during the first four months after the disaster.

Pub. Apr. 72: 40p., U.S. Army, Corps of Engineers, Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Defense

6.0406. STORM CHARACTERISTICS AND FLOOD INTENSITY IN WEST VIRGINIA

W.H. DICKERSON, West Va. University, Morgantown, West Virginia 26506

The objectives of this study are to determine the frequency relationship for West Virginia floods of diurnal, seasonal, and topographic characteristics and the occurrence of extreme floods.

Intensity-frequency relationships will be determined for floods of 1 to 24 hours and for the Weather Service 24-hour flood. Selection of extreme-precipitation events for the data sample will be done by computer. The center around the study of characteristics of extreme storms. The results are expected to be used for delineating areas of homogeneous rainfall and for depicting areal variations of flood frequencies for selected periods. Results can be used in the design of flood control structures.

SUPPORTED BY U.S. Dept. of Interior

6.0407. REGIONAL FLOOD-FREQUENCY ANALYSIS (PHASE II)

D.C. CONGER, U.S. Dept. of the Interior, Madison, Wisconsin 53706

The design of any structure within the flood plain requires a knowledge of the magnitude of floods for that particular water control project. Phase I of this study (1959-70), flood-frequency analysis, have been defined for all size drainage areas and frequencies up to a 25-year flood and from 1 to 24 hours for drainage areas over 20 square miles. For ten years of record are required to determine a 25-year flood for drainage areas under 20 square miles.

With additional data on flood characteristics for streams over the next ten years, the flood-frequency relationships presently determined for streams with any size drainage areas will be improved.

Continue operation of network of crest-stageing stage-rainfall gages to sample flood flows will be correlated with various characteristics (including geology). Also, recent floods at selected sites will be extended using rainfall-runoff model and long-term rainfall data.

netic tape. Six roving gages were calibrated by the Dawdy Model. One roving gage was relocated and another was reestablished. Two crest-stage gages were discontinued and two new ones established.

One or two old crest-stage gages will be relocated and a few new ones established. Crest gages will continue to be rated and indirect measurements verified with current meter measurements. Additional parameters will be studied to give better regression equations. Data will be prepared for the Dawdy Model. Unit rainfall at 5 minute intervals needs to be prepared for 5 long-term U.S. Weather Bureau Stations. This data will be merged with data from the roving gages to generate new flood frequency curves.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0408, HYDROLOGIC EFFECTS OF A SMALL RESERVOIR ON THE WATER SYSTEM OF NEDERLO CREEK, WISCONSIN

P.A. KAMMERER, U.S. Dept. of the Interior, Geological Survey, *Madison, Wisconsin 53706*

Many small impoundments are being planned and built in southwestern Wisconsin for recreation and upstream flood and erosion control. Most of the upper reaches of the perennial streams are spring fed and contain trout. Information is needed on the effects of these reservoirs on the hydrologic systems in the basins under consideration, including changes in runoff, ground-water movement, and spring flow. Information is also needed on the effects of the reservoirs on downstream water quality that may affect trout populations.

1. To define and describe the existing hydrologic system and water quality in the basin. 2. To determine the effects of the reservoir and cultural changes brought about by it on the hydrologic system and water quality in the basin.

The study will be conducted in three consecutive phases. The first phase will consist of defining existing physical and hydrologic conditions by mapping geology and land use, and measuring various hydrologic and water quality parameters. The second phase will document changes during the construction period. The final phase will evaluate hydrologic and water-quality changes caused by the reservoir.

Collection and analysis of basic hydrologic data (streamflow, spring flow, precipitation, temperature, and ground-water levels) are continuing. Suspended sediment concentration, suspended sediment and bed material particle size, and quality data are collected at high flows.

Collection of basic hydrologic data and water quality and sediment data at high flows will continue. When construction begins this summer, collection of water quality and sediment data will be intensified to monitor changes caused by construction activities.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0409, FLOOD INUNDATION STUDY, WISCONSIN

J.O. SHERMAN, U.S. Dept. of the Interior, Geological Survey, *Madison, Wisconsin 53706*

Purpose: To determine inundation limits for flood discharges so that meaningful zoning ordinances may be formulated.

Methods: The priority of areas where flood inundation studies will be conducted is to be determined by potential and/or existing hazard and the availability of topographic and

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

**6.0410, WATER RESOURCES POLICY IN WISCONSIN
VOLUME IV - FLOOD PLAIN MANAGEMENT**

J.A. KUSLER, Univ. of Wisconsin, Water Resources Center, *Madison, Wisconsin 53706*

Abstract: Two basic issues are considered—the administrative constitutionality of regulations to preserve floodplains as open spaces, and the basic problems in planning and coordination of flood plain management efforts at the state, regional, and local elements. The first is a legal research of case law across the nation. In the second issue concerned review of government flood plain management efforts in the southeastern Wisconsin through literature review, telephone surveys, and field studies. An appendix discusses open space regulations and such regulations.

Pub. 1971: 286p., NTIS No. PB-206 223; PC \$3.00

SUPPORTED BY U.S. Dept. of Interior - O.W.R.

6.0411, NEW TECHNIQUES FOR DELINEATING FLOOD PLAIN HAZARD ZONES - SOIL SURVEYS

G.B. LEE, Univ. of Wisconsin, Water Resources Center, *Madison, Wisconsin 53706*

Abstract: Part I describes investigations designed to interpretations of detailed soil maps, as a means of delineating flood plain boundaries for regulatory purposes. Part II describes similar studies based on interpretation of aerial photographs. Six Wisconsin sites were studied. Boundaries of floodplains determined by engineering methods were used as a basis of comparison. Results showed that reasonable boundaries of 100 year floods can be drawn in Wisconsin by interpretation of detailed soil maps. Results of aerial studies showed that flood plain boundaries could be drawn by interpretation of aerial photographs, in areas where physiographic features were distinct.

Pub. 1972: 104p., NTIS No. PB-211 325; PC \$3.00

SUPPORTED BY U.S. Dept. of Interior - O.W.R.

6.0412, REMOTE SENSING FOR RESOURCE MANAGEMENT AND FLOOD PLAIN DELINEATION

C.J. MILFRED, Univ. of Wisconsin, School of Journalism, *Madison, Wisconsin*

Abstract: Remote sensing is becoming an extremely important research tool in modern resource management. Water resource managers can use remote sensing to provide supplemental information in regions where data has been hampered by the lack of suitable hydrologic and other resource information. Continued pressure for encroachment and development on flood plains will need for more comprehensive planning based on accurate information about an entire river watershed. With respect to flood plain delineation, remote sensors cannot be used to predict the height of flood waters. They can provide information to indicate areas that are flooded which should help improve flood prediction on theoretical models. Remote sensors offer a new resource inventory system which can be used to supplement traditional detailed studies and serve as an important source of information in regions where detailed studies are not available. Remote sensors generate a great deal of information, there is danger of accumulating more information than can be used.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0413, THE USE OF DETAILED SOILS INFORMATION FOR DELINEATING AND REGULATING FLOOD PLAINS - LEGAL AND ADMINISTRATIVE CONSIDERATIONS

D.A. YANGGEN, Univ. of Wisconsin, Water Resources Center, Madison, Wisconsin 53706

Abstract: The preferred method for establishing flood zones is by means of detailed engineering flood predictions and hydraulic studies; there are situations where such studies will be delayed for a number of years. Rather than leave areas unregulated, such as scattered flood plains used for recreation and agriculture, detailed soil survey information can be used, especially in mature landscapes, to delineate regulatory flood hazard areas. The legal considerations relevant to Wisconsin flood plain zoning, as well as the advantages and limitations of using soils information for establishing flood plains, are identified.

Pub. 1972: 77p., NTIS No. PB-211 324: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

6.0414, FLOOD INVESTIGATIONS IN WYOMING

H.W. LOVHAM, U.S. Dept. of the Interior, Geological Survey, Cheyenne, Wyoming

The optimal design of highway drainage structures requires a knowledge of the magnitude and frequency of peak discharges expected at a given site. This knowledge may be derived either from data collected at the desired location or from regional analysis of peak-flow characteristics. The paucity of peak-flow data for small drainage basins in Wyoming, particularly for ephemeral streams, restricts the use of presently available regionalization techniques. A network of peak-flow, partial-record sites is needed to supplement the existing network of continuous-record streamflow stations.

The main objective is to obtain sufficient basic hydrologic data to define the magnitude and frequency of floods on a regional basis for the entire state and to publish the interpretative analysis in easily usable form. On request from the cooperator, flood-flow characteristics of streams at specific sites will be determined by studying such factors as: history of past floods; distribution of flow across the flood-plain and main channel; and mean velocities in the main channel and overflow areas.

Available flood data will be analyzed, and sites for crest-stage gages will be selected where they will supplement best the existing network of continuous-record stream-gaging stations. Stage-discharge relations will be defined for each crest-stage site by recording water stage and by making current-meter measurements, indirect measurements of peak flow, or by using the 'step-backwater method.' Basin characteristics that are pertinent in flood-frequency analysis will be determined. Frequency characteristics will be related to basin characteristics by regression analysis. Peak-flow measurements will be made at miscellaneous sites where unusual floods occur.

Modification of the crest-stage gage network was continued in order to intensify data-collection efforts in the plains areas of the state. Four stations were discontinued, three new stations were established, and eight stage-rainfall stations (from project WY 64-011C) were converted to crest-stage stations. Data from all partial-record stations having five or more

letter reports were submitted to the Wyoming Highway Department, supplying them with requested information (Text Abridged)

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

6.0415, STUDY OF FLOOD HYDROGRAPHS FOR SMALL DRAINAGE BASINS IN WYOMING

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Cheyenne, Wyoming

Optimum design of highway culverts requires knowledge of the magnitude and frequency of peak discharges and volumes expected at a given site. Knowledge of the characteristic shape of flood hydrographs is essential in culvert design if highway embankment storage is to be considered in reducing the peak discharge. Also there is little information available on the diverse climatic and physiographic conditions that govern floods on small drainage areas in Wyoming.

The objectives of the study are to: (1) Define the magnitude and frequency of flood volumes to be expected from small drainage areas in Wyoming. (2) Define the characteristic shape of flood hydrographs in relation to the physical characteristics of the basins. (3) Develop a rational method of accounting for the effect of embankment storage which will be useful in culvert design.

Rainfall and runoff data are collected on 49 drainage basins (under 11 sq. Mi.). Principal instrument on each basin is a stage-rainfall recorder with supplementary recording and nonrecording rain gages on basin perimeters. Stage-discharge relations will be determined; physical characteristics of the basins will be measured and runoff characteristics will be determined from data collected by the gages. Rainfall-peak discharge-volume relations will be determined and discharge and volume frequencies will be developed. Computerized programs will be used for statistical analysis such as multiple regression and for synthesizing runoff by means of rainfall runoff models.

A modification to the infiltration concept of the rainfall-runoff has provided better results in basin-model calibration testing of four stations. The modification, considered applicable to semi-arid areas, considers infiltration throughout a drainage basin as being nonlinear in both distribution and time. A 60-year record of annual peaks and volumes has been synthesized from a 60-year rainfall record at Sheridan, Wyoming.

Data collection will be continued at 24 of the 49 stations. This is the final year of the study and 4 stations are considered to have sufficient data and 25 stations have insufficient data and have been discontinued. Rainfall-runoff basin-model calibration will be continued and long-term runoff records will be synthesized from long-term rainfall records. A final report will be completed.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

7. HAIL

INDIVIDUAL ASSISTANCE

7.0001, ESTIMATING CROP LOSSES DUE TO HAIL. STATISTICAL SUPPLEMENT TO AGRICULTURAL ECONOMIC REPORT NO. 267

L.M. BOONE, U.S. Dept. of Agriculture, Economic & Statistical Analysis Div., Washington, District of Columbia 20250

vested acre and as a proportion of annual production, by county and crop in the 10-State sample area; estimated annual hail losses to major crops, by county and per square mile of land in the 10-State sample area; and lists of counties where crop production data were unavailable or inadequate during the study period, 1966-70.

Pub. Sept. 74: 84p., Stat. Sup. to Ag. Economic Rpt. No. 267, U.S. Dept. of Ag., ERS, Wash., D.C.

Abstract provided by FIDAA.

SUPPORTED BY U.S. Dept. of Agriculture - E.R.S.

7.0002, MEASUREMENT AND ANALYSIS OF FARM RISKS, LOSSES, AND INSURANCE

L.A. JONES, U.S. Dept. of Agriculture, Farm Production Economics Div., Washington, District of Columbia 20250 (FE3-5-54-00)

Objective: Determine farm risks, their causes and economic cost, and methods of dealing with them. Maintain and improve statistical series on crop insurance premiums and indemnities, fire losses, farm accidents, farm property and liability insurance, social security, and workmen's compensation.

Approach: Collect data from insurance companies, State and Federal insurance agencies, and farmers on farm insurance coverage, premiums, and indemnities by type of insurance and geographic area. Analyze causes of insurance losses and developments in insurance legislation and insurance policies. Develop information from farm surveys and other sources on farm risks and risk bearing methods.

Progress: Crop-hail insurance and Federal crop insurance in 1972 totaled a record \$5.0 billion. Premiums amounted to \$176 million and indemnities \$104 million. Crop-hail insurance companies paid indemnities of \$79 million and the Federal Crop Insurance Corporation paid \$25 million. An analysis of insurance to reimburse farmers and ranchers for production losses due to pesticide bans resulted in a publication. A staff paper, prepared for internal use only, attempted to establish criteria for designating emergency areas and determining individual eligibility for emergency loans.

SUPPORTED BY U.S. Dept. of Agriculture - E.R.S.

7.0003, A STUDY OF CROP-HAIL INSURANCE RECORDS FOR NORTHEASTERN COLORADO WITH RESPECT TO THE DESIGN OF THE NATIONAL HAIL EXPERIMENT

P.T. SCHICKEDANZ, State Water Survey, Urbana, Illinois 61801

Abstract: The specific purpose of the proposal was the evaluation of selected statistical tests and experimental designs related to the daily experimental unit in a single area through use of historical crop-hail loss data. This purpose was originally intended to be accomplished by evaluating the sampling requirements for three basic experimental designs utilizing the daily experimental unit and crop insurance data for crop-damage seasons. These designs included: random-experimental, in which days are randomized over a single target area into seeded and non-seeded days with the non-seeded days being the control; random-historical, in which a random choice is made of days to be seeded over a single target area with the historical record being the control; and continuous-historical in which all the hail days over a single target area are seeded with the historical record being the con-

Pub. Nov. 70: 96p., NTIS No. PB-197 644; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

7.0004, SOYBEAN PHYSIOLOGY AND MANAGEMENT

J.J. FORST, Purdue University, Agricultural Experiment Sta., Lafayette, Indiana 47907 (IND01684)

Objective: Evaluate certain morphological and physiological responses of field crops to cultural practices and environmental conditions. Examine crop response to environmental hazards that defoliate or damage the crop.

Approach: Field and/or laboratory studies will be conducted with soybeans. Emphasis will be placed on measuring the effects of deletations environmental phenomena on crop growth and yield. Defoliation, stem breakage, and stand reduction may be used to simulate natural damage. Measurements of photosynthesis, translocation, crop yield and quality will be emphasized.

Progress: A study was initiated to determine the effects of 100% defoliation, and one-half height cut-off treatments applied at six stages of reproductive growth, on Hark and Beeson variety soybeans. Similar experiments were conducted by Iowa and Arkansas researchers to determine how response varied at these locations. This information is desired by the Hail Insurance Industry to determine if one hail loss adjustment chart appears adequate for the main soybean producing areas. All defoliation treatments reduced seed yield, with yield reductions being greater on Hark than Beeson variety at any one growth stage. Seed yield of Hark and Beeson varieties was reduced 83% and 77% from check yields when plants were defoliated at the R8 stage. Yield reductions due to one-half height cut-off treatments were similar to but more variable than those for defoliations applied at comparable growth stages. Date of maturity was delayed slightly by treatments applied at early reproductive stages, whereas treatments applied at later stages caused plants to mature 3 to 6 days earlier than untreated plants. The effect of 0, 25, and 50% stand reduction applied at the 6 trifoliate leafage and an early reproductive stage was studied in another experiment. Slight, non-significant yield increases were associated with early stand reduction treatments. Seed yields were reduced a maximum of 26% when one-half of the plants were removed at the early reproductive growth stage.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

7.0005, ECONOMIC AND INSTITUTIONAL CONSIDERATIONS OF SUPPRESSING HAIL

L. BOONE, Univ. of Nebraska, U.S.D.A. Nat. Resour. Ec. Div., Lincoln, Nebraska 68503 (NRE9-2-28-01)

Objective: Analyze crop losses from hail, by crop and by county, for selected regions of the United States; analyze prospective shifts in patterns of agricultural production that might be induced by large scale hail suppression; analyze comparative economics of hail insurance, hail suppression and no protection for selected farm resource situations; and analyze alternative institutional arrangements for organizing, operating and financing operational hail suppression systems.

Approach: Estimated crop losses from hail will be derived from long-term insurance loss records and agricultural production statistics. Use linear programming to evaluate the prospective effect of hail suppression upon the relative comparative ad-

State, and by county for a tentative sample, for hail suppression. Over 70 percent of hail loss involves 6 crops located in 23 States. Land inventories, cropping patterns, and production cost budgets by county, crop, and soil resource group were prepared for Nebraska. These data are basic to analyses of the impact of hail suppression on cropping patterns, comparative producing advantage, and selection of the best means of spreading crop loss risk at the farm level in areas of high hail risk. A field study of organizational, operational, and financial characteristics of existing hail suppression projects has begun. The purpose is to determine the type of project that will best satisfy all parties concerned.

SUPPORTED BY U.S. Dept. of Agriculture - F.R.S.

7.0006, WEATHER MODIFICATION IN NORTH DAKOTA
W.J. PROMERSBERGER, North Dakota State University, Agricultural Experiment Sta., Fargo, North Dakota 58103 (ND-H-04-018)

Objective: Characterize the climatology of hail storms in southwestern North Dakota. Determine whether seeding convective storms causes a reduction in intensity of hail and impact energy of hailstorms and causes changes in other hail parameters in seeded areas as compared with adjacent non-seeded areas, and whether seeding clouds with silver iodide causes a precipitation increase in seeded areas and a possible 'rain shadow' downwind from commercial weather modification areas.

Approach: In North Dakota, hail and drought losses amount to about 50% of all Federal Crop Insurance payments for crop losses due to natural hazards. A group of farmers in southwestern North Dakota are seeding storms with silver iodide in an effort to suppress hail. A weather modification firm seeds clouds in the north central part of the state for precipitation increase.

Progress: Project has been inactive because of lack of personnel to collect data. The graduate research assistantship assigned to this project has been vacant for over a year. A conference was held with the Institute of Atmospheric Sciences at Rapid City, South Dakota. The results of this conference indicate that this project should be continued. The interest in weather modification in North Dakota is increasing.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

PUBLIC ASSISTANCE

7.0007, ECONOMIC AND INSTITUTIONAL CONSIDERATIONS OF SUPPRESSING HAIL

L.M. BOONE, U.S. Dept. of Agriculture, Economic Research Service, Washington, District of Columbia

The fund transfer will provide support for the final portion of the third year of the study by the Economic Research Service of the U.S. Department of Agriculture to estimate the economic benefits which may be derived from the application of hail suppression technology to severe convective storms which threaten crops in areas subject to heavy hail damage. During the first year of the study, an estimate of crop losses was made by county for selected regions of the U.S. and county clusters that would be amenable to potential hail suppression activities were determined. During the

with the National Center for Atmospheric Research. The project is a cooperative institutional arrangement for organization and financing an operational hail suppression system. SUPPORTED BY U.S. Natl. Science Foundation

7.0008, STUDIES OF HAIL DATA IN 1970-72
S.A. CHANGNON, State Water Survey, Urbana, Ill.
Abstract: The research effort of the project has concerned continuation of the 1967-79 field network and ensuing analyses, plus studies relating to the hail benefits and economics of hail suppression. (1) types of surface hail and rain data, (2) evaluation of suppression efforts, and (4) continued refinement of recording gage. An unfulfilled goal was to gather data to be used in evaluating the hail detection capabilities of a unique dual wavelength radar system. The project further verified the existence of great areal-spaces of hail. Importantly, this network of hailpads is denser than the prior Illinois networks, providing hailstreaks.

Pub. Dec 72: 42p., NTIS No. PB-228 777/9: 1.45.

SUPPORTED BY U.S. Natl. Science Foundation

DISASTER MITIGATION

7.0009, URBAN GEOLOGY PLAN FOR CALIFORNIA: THE NATURE, MAGNITUDE, & COSTS OF NATURAL HAZARDS & RECOMMENDATIONS FOR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threatened \$55 billion loss in California's urban areas by the year 2000. The problems are earthquake shaking, mineral resources to urbanization, landsliding, erosion activity, expansive soils, fault displacement hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of reduction measures, and agencies responsible for their solution.

Pub. Jan 73: 111p., NTIS No. PB-222 447/5: 1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

HAZARD REDUCTION

7.0010, NATIONAL HAIL RESEARCH EXPERIMENT: SUPPORT FOR 1973 - COLORADO

J.W. FIROR, Natl. Center for Atmosph. Res., Boulder, CO 80302

Funding for the National Hail Research Experiment for FY 1973, has been accomplished in two increments. The first increment was completed in August 1972, as a

to C-760. This award will provide the second increment, and will complete the funding required for the second field operating summer of NHRE in northeastern Colorado in 1973. This project is being conducted by the National Center for Atmospheric Research (NCAR) as a part of a five-year study of hailstorm microphysics and dynamics with the objective of testing the feasibility of suppressing large hail formation in storms through silver iodide seeding. Research is being accomplished through the participation of seven university groups and the cooperation of five federal agencies. The first field operating summer during May, June, and July 1972, provided 22 hail days. Seeding was conducted on 12 of these days, and on 10 days observations were made on cloud mechanisms using instrumented aircraft, dual wavelength radars, and 600 square mile ground meteorological network. High values of liquid water content in the hail forming areas of the storm were observed by means of an armored F-28 research aircraft. Observations and seeding will be continued during the summer of 1973 to provide additional data.

SUPPORTED BY U.S. Natl. Science Foundation

7.0011, THE NATIONAL HAIL RESEARCH EXPERIMENT SUMMER 1973 SUMMARY REPORT

UNKNOWN, Natl. Center for Atmosph. Res., Boulder, Colorado 80302

Summer 1973 was the second of five planned field research seasons of the National Hail Research Experiment to further our understanding of the physics and dynamics of hailstorms and to test the feasibility of hail suppression.

Valuable new cloud physics data were gathered in 16 vertical penetrations of the sailplane Explorer in the updraft of cumulus congestus and in 27 horizontal penetrations of the armored F-28 aircraft through the core of more severe convective storms. In addition, several multi-aircraft research flights around and under storms contributed new observations on the dynamics of severe storms. Also, the detection of hail has been confirmed and the internal distribution of water substances throughout the life cycle of severe storms was again observed and recorded by 2 dual-wavelength research radars. Dual-Doppler research radars also provided new data on the wind fields in and below storms.

There were 6 declared Hail Days, 2 of which were seeded with airborne silver iodide flares burned in the storm updraft at cloud base.

No significant increase in silver concentration could be detected, from the beginning to the end of each season or from season to season, in the ecological systems monitored in the experimental area.

Pub. Dec. 73: 93p., Natl. Hail Res. Exp. Data Rpt. No. 73/2, NSF, Wash., D.C.

Abstract provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

7.0012, HAIL AND LIGHTNING - COLORADO

H. WEICKMANN, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302

Technical objective: Develop and employ observational techniques and equipment to determine the dynamics, the physical and meteorological structure, and the mechanisms of the hail producing storms. To investigate the feasibility of in-

Approach. Provide technical direction for the surface observation network of the National Hail Research Experiment (NHRE) and conduct storm dynamics mesoscale and microscale research aboard RIF aircraft. Provide technical direction for research efforts associated with Kennedy Space Center lightning suppression by chaff seeding of the northeast Colorado area.

Results of APCL participation in NHRE are: 'NOAA Hail Research Project -- Summer 1972 Report' by B. B. Phillips. Results of APCL direct participation are reported in 'Phase II of Lightning Control Project' March 1972, by H. W. Kasemir.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

7.0013, EXTENDED AREA EFFECTS FROM WEATHER MODIFICATION

L.O. GRANT, Colorado State University, School of Meteorology, Fort Collins, Colorado 80521

This grant is the second phase of a three year project to evaluate the reality and magnitude of extraneous effects that may result from either planned or unplanned localized weather modification, with a significant study directed toward the extra area effects of the National Hail Research Experiment. The societal impact of this research rests not only in the degree of control to be required of planned weather modification at various governmental levels but also in gaining understanding of the extent to which society is modifying its larger scale climate through the unintended localized weather effects of metropolitan

SUPPORTED BY U.S. Natl. Science Foundation

7.0014, NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING

UNKNOWN, U.S. Natl. Science Foundation, Washington, D.C. 20550

Abstract: The statement concerns experiments in which silver iodide will be delivered by various means in selected developing hail cells to develop and test methods for modifying hail storms in order to suppress the occurrence of hail of damaging size. The test area is centered on Pawnee National Grasslands in northeastern Colorado, which comprises parts of Logan, Morgan, and Weld Counties, Colo.; Cheyenne and Kimball Counties, Nebraska; and Crook County, Wyo. The temporary alteration of precipitation patterns in the sparsely settled test area will have a direct impact on the local economy. The level of silver resulting from the silver seeding is expected to be higher than for other seeding methods. Hazards from rockets and rocket parts are minimized. Pub. Mar 72: 21p., NTIS No. PB-207 539-F: Price \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

7.0015, DESIGN OF HAIL SUPPRESSION EXPERIMENT IN ILLINOIS

G.M. MORGAN, Univ. of Illinois, School of Librarianship, Urbana, Illinois 61801

This grant provides for the first half of the second year of a study to determine the desirability of a preliminary design for a hail suppression operation in the State of Illinois, and to so advise the Illinois government and citizens. The study draws upon data taken in Illinois during 1967, 1968, 1969, and 1970.

Research Experiment
SUPPORTED BY U.S. Natl. Science Foundation

7.0016, THUNDERSTORMS AND HAIL DAYS PROBABILITIES IN NEVADA

C.M. SAKAMOTO, U.S. Dept. of Commerce, Natl. Weather Service, Salt Lake City, Utah

Abstract: A computer program was developed to provide probabilities for selected number of thunderstorm days in a month and in a year. In addition, probabilities for selected number of hail days in a year were determined. Two distribution models were tested in the analysis: (a) Poisson and (b) negative binomial. The program was applied to five locations in Nevada. Results show that for Nevada, the Poisson distribution fits the monthly thunderstorm days for the months November through April, while the negative binomial fits this variable better from May through October. The negative binomial model also fits the annual thunderstorm days in Nevada. Annual hail days distribution favored the Poisson distribution where the frequency was small. The negative binomial fitted the annual hail days distribution at Ely and Elko. Cumulative probabilities are presented for these variables at the five sites, including Elko, Ely, Las Vegas, Reno, and Winnemucca.

Pub. Apr. 72: 33p., NTIS No. COM-72-10554. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

7.0017, TRACER STUDIES IN THE NATIONAL HAIL RESEARCH EXPERIMENT (NHRE)

J.A. YOUNG, Battelle Memorial Institute, Richland, Washington 99352

Description: Three specific areas have been outlined which can make a substantial contribution to the understanding of severe convective storms. (1) Multiple tracer releases can be very useful in the study of air movements and scavenging within a convective storm. (2) AgI labeled with in-line-129 can be uniquely distinguished from normal AgI by neutron activation analysis, and therefore has a great potential in helping to establish the most desirable location in a hailstorm for seeding to suppress damaging hail. (3) Simultaneous measurements of cosmogenic radionuclides, nuclear weapons produced radionuclides, and radon daughters provide a unique means of studying air and hydrometeor trajectories and the rates and mechanisms of the scavenging of atmospheric aerosols either during nucleation or subsequently.

SUPPORTED BY U.S. Atomic Energy Commission

7.0018, STUDY OF THE FEATURES AND ENERGY BUDGETS OF NORTHEASTERN COLORADO HAILSTORMS - ALSO, WISCONSIN

C.E. ANDERSON, Univ. of Wisconsin, School of Natural Sciences, Madison, Wisconsin 53706

This grant provides part of the third year of support for a three year continuing grant CI-31278X to study the dynamics, energetics, and cloud microphysics in hailstorms which are typical of those being studied by the National Hail Research Experiment (NHRE) in Northeastern Colorado. Data from storms in the Madison, Wisconsin area and data from the National Hail Research Experiment will be used to test and develop a suitable two dimensional mathematical model of a hailstorm which would simulate the actual fields of motion, temperature, pressure, precipitation, hailstone formation, and their time dependence as experienced in a typical storm. The

minutes is required to activate seeding them in the proper position beneath the sometimes requires decisions to be made. echo has confirmed that the storm will phase. An initial model has been developed to give reasonably representative results with available to date. Further refinements will first year of data from NHRE becomes an accurate comparison.

SUPPORTED BY U.S. Natl. Science Foundation

8. HURRICANES

INDIVIDUAL ASSISTANCE

8.0001, THE FEDERAL RESPONSE TO STORM AGNES; A REPORT TO THE SECRETARY ON PUBLIC WORKS, SUBCOMMITTEE ON DISASTER RELIEF

UNKNOWN, U.S. Exec. Office of the President, Preparedness, Washington, District of Columbia

This report covers the activities of the Office of Preparedness and other Federal agencies that were declared major disaster areas by Hurricane Agnes and the ensuing tropical storm. Together in one report the activities of state, local, State, Federal, and voluntary agencies, community services and aiding individuals are the effects of this disaster.

Pub. May 73: 62p., Fed. Disaster Assistance, HUD, Wash., D.C.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing and Urban Development

PUBLIC ASSISTANCE

8.0002, COASTAL STORM DAMAGE IN DELAWARE; A REFERENCE TO THE DELMARVA PENINSULA, DELAWARE, MARYLAND, VIRGINIA

F.J. SWAYNE, Univ. of Delaware, School of Civil Engineering, Delaware 19711

Objectives: Recent storm damage along the Delaware coast is the result of both meteorological and human factors. The project will: (1) provide information on the extent of past storms including water levels, wind patterns, storm tracks and the resulting damage to the natural and human environment; (2) delineate areas with a significant hazard potential from present-day land use; (3) designate those areas where past or proposed development or modification of land use is increasing damage potential as the result of industrialization or recreational use; (4) identify and recommend actions for limiting the future damage from storms in Delaware.

How Information will be applied: This information will be relayed to the Delaware portion of the Atlantic Coastal Program for the purpose of developing coastal zoning and other measures to reduce damage hazards to be implemented by the

civil defense records, highway department, and historical documents. 2. Compilation of predicted tide heights and a comparison to observed water levels during coastal storms in Delaware Bay, and ocean coast. 3. Map of the coastal areas of Sussex County inundated during maximum high water, March, 1962. 4. Delineation of six primary land uses in the coastal zone of Sussex County, Delaware as shown on the 1954 and 1961 aerial photos.

For additional information pertaining to this project contact Dr. William S. Gaither, Dean, College of Marine Studies, University of Delaware, Newark, Delaware 19711.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0003, EFFECTS OF TROPICAL STORM AGNES ON THE CHESAPEAKE BAY

D. CORRELL, Smithsonian Institution, Washington, District of Columbia 20560

To participate in the preparation of a summary report on the effects of Tropical Storm Agnes on the Chesapeake Bay as well as in the preparation of an appendix to the report.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0004, FEDERAL PLAN FOR METEOROLOGICAL SERVICES & SUPPORTING RESEARCH - FISCAL YEAR 1974

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

Abstract: The federal plan is the ninth in an annual series developed by the federal coordinator for meteorological services and supporting research in response to section 304 of Public Law 87-843. This plan focuses on the provision of meteorological services that will contribute to the public health, safety and welfare and to the effective use of the environment. The highest priority is being given to additional efforts needed to observe, predict, and provide warnings on severe storms, such as hurricanes and tornadoes.

Pub. Jun. 73: 62p., NTIS No. COM-74-10179/1: PC \$5.25 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0005, ATLANTIC HURRICANE SEASON OF 1972

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service, Miami, Florida

Abstract: A general overview of the 1972 hurricane season in the North Atlantic is presented together with detailed accounts of all named tropical cyclones. The 1972 hurricane season was notable for at least three reasons. First, fewer tropical storms and hurricanes formed in the Atlantic than in any season since 1930. Secondly, in 1972 as in 1971, most of the tropical cyclones developed in temperate latitudes, Agnes being the only one to form in the Tropics. Finally, 1972 will be remembered as the year of record hurricane damage. Hurricane Agnes, following a 700 mile overland excursion after its landfall in northwest Florida, was responsible for the most damaging floods ever recorded. Excessive rains fell in Pennsylvania, Maryland, and Virginia. Property damage in the U.S. attributed to Hurricane Agnes is estimated to be near \$3.1 billion.

Pub. Jan. 73: 12p., NTIS No. COM-73-50496-04-03.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0006, APPLICATION OF ECONOMIC ANALYSES TO HURRICANE WARNINGS TO RESIDENTIAL AND RETAIL ACTIVITIES IN THE U. S. GULF OF MEXICO COASTAL REGION

Abstract: Hurricane warnings cause people and the predicted path of the cyclone to take action to reduce damage and/or loss of life. Sometimes and their attendant costs are avoidable, since a of the coast is alerted than that which the hurricane affects. Using general population densities and damage costs due to storms, the authors present game- and decision-theory approach to estimate economic benefits of more accurate prediction. savings to this economic sector for a substantial in 24-hr forecasting accuracies is shown to be million in the first year. A general equation is various combinations of improvement levels, probabilities, percentage of those who protect, and warnings per season.

Pub. Mar. 72: 7p., NTIS No. COM-73-50496-02-0

SUPPORTED BY U.S. Dept. of Transportation

8.0007, THE NATURE AND EXTENT OF STRUCTURAL DAMAGE CAUSED BY HURRICANE CAMILLE

H.S. SAFFIR, Unknown Inst. or Indiv. Grant, Miami

Abstract: The study furnishes a professional opinion of the percentage of structural damage caused by Hurricane Camille in Mississippi in August 1969. Results are given of the damage caused by tidal storm surge and that caused by or initiated by wind. The report asserts that at least 60 percent of the structural damage was initiated by wind action or was initiated by wind action. reference is made to the effects on the Pass Christian-Biloxi coast, information is given on records of previous hurricanes.

Pub. Sep. 72: 77p., NTIS No. COM-73-10229: PC \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0008, EFFECTS OF HURRICANE CAMILLE ON THE LANDSCAPE OF THE BRETON-CHANDELIER ISLAND CHAIN AND THE EASTERN PORTION OF THE MISSISSIPPI DELTA

L.D. WRIGHT, Louisiana State Univ. Systems, Coastal Science Institute, Baton Rouge, Louisiana 70803

Abstract: Air and ground reconnaissance immediately after the passage of Hurricane Camille disclosed significant changes to the natural landscape of the Breton Island and to the eastern portion of the lower Mississippi Delta. Considerable dissection and redeposition of beach and barrier formations, and total destruction of numerous sections. Trends of redistribution of material strongly reflected the final direction of the reduced mass transport of water. In the lower delta, the damage was mainly to marsh vegetation and was a result of high water and surge currents directed almost north to south.

Pub. Feb. 70: 24p., NTIS No. AD-709 427: HC \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0009, ASSESSMENT OF THE PHYSICAL AND GEOLOGICAL EFFECTS OF TROPICAL STORMS ON THE UPPER CHESAPEAKE BAY AND ITS TRIBUTARIES

J.R. SCHUBEL, Johns Hopkins University, Graduate School of Oceanography, Baltimore, Maryland 21218

this period. From 19-25 June 1972 excessive amounts of rain fell throughout much of Virginia, Maryland and Pennsylvania, accompanying the passage of tropical storm Agnes. The flooding that resulted was of record or near record proportions throughout the Chesapeake Bay region. Agnes unquestionably represents a major event in the history of Chesapeake Bay. The purpose of the study is to examine samples taken following the storm to quantify the extent to which such a major event affects the estuary.

SUPPORTED BY U.S. Natl. Science Foundation

8.0010, REGIONAL CODE ENFORCEMENT - HANCOCK, HARRISON AND JACKSON COUNTIES, MISSISSIPPI

P. MONTJOY, Coast Code Administration, Gulfport, Mississippi

Abstract: The document contains the case history of a project to design, develop, and test a regional code enforcement program in the Mississippi coastal area immediately after the devastation caused by hurricane Camille. The report covers the actual background and events in the establishment of a code, a regional code enforcement agency and the funding of such a program, and presents an evaluation of the success and failures of such a program. Also included is a model approach in developing and implementing a code and a code enforcement program. The project was prepared with the idea that it would be most helpful for other areas of the United States which have multi-governmental jurisdictions that would like to consider a similar program.

Pub. 1972: 95p., NTIS No. PB-212 781/9: PC \$6.75 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

8.0011, GRANT TO DESIGN A REBUILDING PLAN FOR GULFPORT, MISSISSIPPI, TO RESTORE THE DAMAGE OF HURRICANE CAMILLE, VOLUMES I, II, & III (AB-BREV)

UNKNOWN, State Res. & Dev. Center, Jackson, Mississippi

Abstract: The report includes four publications prepared for the port of Gulfport under EDA funding. They contain a management and operations survey of the Mississippi State Port Authority at Gulfport, growth potentials of the port, a master plan for development of port facilities, and costs of developing Mississippi's coastal waterways and ports. Volumes I-III present overviews of work performed in development of a Gulfport master plan, where one existed even before the hurricane; the port's role in waterborne commerce on the Gulf Coast; and port management methods. The growth potentials and management and operations survey are also included. Role of the port in Mississippi's economy, typical characteristics of small ports and Gulfport's assets and liabilities compared with those of other U.S. ports are discussed.

Pub. Apr. 71: 101p., NTIS No. COM-71-00931: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - Econ. Dev. Admin.

8.0012, GRANT TO DESIGN A REBUILDING PLAN FOR GULFPORT, MISSISSIPPI, TO RESTORE THE DAMAGE OF HURRICANE CAMILLE, VOLUMES IV & V (AB-BREV)

UNKNOWN, State Res. & Dev. Center, Jackson, Mississippi

canseways, piers, and railroad piers in Pascagoula, St. Louis Bay, and Pearl River. Plan concludes Gulfport cannot succeed at other ports for heavy traffic in bulk export needs more storage facilities and land well as to expand the Port laterally. The 40-foot channel depth.

Pub. Apr. 71: 111p., NTIS No. COM-71-00930: \$0.95

SUPPORTED BY U.S. Dept. of Commerce - Admin.

8.0013, TEXAS COAST HURRICANE STUDIES

N.J. BROGDON, U.S. Army, Estuaries, Mississippi 39180

Purpose of study/investigation: To determine of hurricane surge protection plans for complex, including effects of the plan on tides, salinity, shoaling regimens, deep navigation, and dispersion characteristics.

Approach plan: Tests were conducted in field to determine the effectiveness of protection achieved by plans for hurricane surges and the effect of modification of tides, currents, salinity, and tides for normal tides.

Progress to date: It is apparent that either hurricane protection plans would provide an area inland from the barrier when the area were closed. The Alpha plan, located on the Gulf of Mexico, would provide protection since it shelters practically the entire area of the coastline. The Gamma plan leaves unprotected West Bay, the entire city of Galveston Bay. The Texas City, LaMarque-Hitchcock completed, will provide protection for surges of 15 ft msl. Test results indicate the Alpha barrier would have no significant effect on tides, salinities, circulation, or pollution. The Gamma barrier would cause slight prism and salinities.

SUPPORTED BY U.S. Dept. of Defense

8.0014, SURVEY OF GULF COAST DAMAGE RESULTING FROM HURRICANE CAMILLE, AUGUST 1969

M.E. CRISWELL, U.S. Army, Waterways, Vicksburg, Mississippi 39180

Abstract: The report describes the damage by an inspection team sent to the Mississippi Gulf Coast regions after Hurricane Camille but relatively small tropical storm, came to port, Mississippi, late on 17 August 1969. The storm damage are included. Extensive damage both from the unusually high winds and from the extremely high tides could be seen. Waves. Damage was greatest in low areas adjacent to the coastline. Because of the material properties for the various buildings of the loading, the report presents mainly. More ductile buildings, such as heavy construction, appeared to have survived t

storm damage indicated a need for more lateral strength in buildings, especially masonry structures, and for more adequate design of connections and other details.

Pub. Apr. 70: 158p., NTIS No. AD-707 941: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0015, HURRICANE CELIA REDEVELOPMENT

UNKNOWN, U.S. Coastal Bend Reg. Comm., *Corpus Christi, Texas*

Abstract: The objective of the report is to catalogue a preliminary inventory of priorities and needs for each city, county, and school district within the seven county Hurricane Celia disaster area.

Pub. Oct. 70: 35p., NTIS No. PB-195 171: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

8.0016, MEMORABLE HURRICANES OF THE UNITED STATES SINCE 1973

A.L. SUGG, U.S. Dept. of Commerce, Natl. Weather Service, *Fort Worth, Texas* 76102

Abstract: Hurricanes which have made landfall in the United States or have been near misses are cataloged from 1973 through 1970. A track of each hurricane is given along with atmospheric pressure, wind velocity, damage estimates, and other relevant data.

Pub. Apr. 71: 56p., NTIS No. COM-71-00610: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A

8.0017, NATURAL DISASTERS OPERATIONS PLANNING FOR SLOWLY DEVELOPING DISASTERS, VOLUME I

A. SACHS, Inst. for Defense Analysis, *Arlington, Virginia* 22202

Abstract: The paper describes a prototype natural disaster operations plan for slowly developing natural disasters such as hurricanes, floods, or forest fires. An investigation was concerned with the emergency operations of local jurisdictions (municipalities or counties) and of the state pertaining to natural disasters. It considered the interactions among these jurisdictions from the initial organization and training phase through mobilization of local forces and evacuation, to eventual return and rehabilitation of the evacuees.

Pub. Jul. 72: 105p., NTIS No. AD-749 032: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

DISASTER MITIGATION

8.0018, URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREVIATED)

J.T. ALFORE, State Div. of Mines & Geology, *Sacramento, California* 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970

describes the nature, distribution, and magnitude of the problem, as well as costs and effectiveness of prevention measures, and agencies responsible for the problem.

Pub. Jun. 73: 111p., NTIS No. PB-222 447/5: PC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

8.0019, CONCRETE BLOCK RETENTION WALLS, BENEDICT, MARYLAND

J.V. HALL, U.S. Army, Coastal Engin. Res. Center, *Washington, District of Columbia* 20016

Abstract: Although the project has been completed in one year, it has protected the backshore area through winter storms. Figure 9 shows comparative photos of the area before and during construction, at completion, and after. The problem of protecting banks and bays from the lower reaches of rivers entering Chesapeake Bay and those of the bay, has always been difficult since the problem areas consist of small parcels of land with cottages in individual ownership. Many owners are reluctant to expend large sums of protection. As a result, the low-cost, do-it-yourself method of shore protection is numerous. The method outlined herein appears to meet the requirements. This system can no doubt be installed by the owner on a do-it-yourself basis at a cost even lower than the contract price for the protection at Friendsville, Tennessee.

Pub. Jan. 64: 15p., NTIS No. AD-440 882: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0020, NATIONAL HURRICANE OPERATIONS PLAN, UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., *Washington, District of Columbia* 20001

Abstract: The report is the 11th edition of the Interdepartmental Plan. It presents the procedures and agreements at the annual Interdepartmental Hurricane Conference and outlines the responsibilities of cooperating agencies. Following a chapter on definitions to facilitate communications, one chapter deals with tropical cyclone forecasting information to be furnished by the National Weather Service to the Department of Defense. One chapter is devoted to information on aircraft reconnaissance and another to the joint radar tropical cyclone observing and reporting. Subsequent chapters deal with the collection and dissemination of tropical cyclone reports; the designation of tropical depressions and cyclones; alternate hurricane warning systems; Atlantic-transfer control master plan and National Service transfer plan; tropical storm surveillance; the deployment of experimental environmental observation stations; and finally addresses to which special news releases are sent.

Pub. Jun. 72: 132p., NTIS No. COM-72-11238: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A

8.0021, NATIONAL HURRICANE OPERATIONS PLAN, 1974

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., *Washington, District of Columbia* 20001
An Interdepartmental Plan was first issued in 1962.

mutual concern related to the Atlantic and Pacific hurricane warning services.

Pub. Jun. 74: 122p., FCM 74-5, U.S. Dept. of Comm., NOAA.
Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0022, FINAL REPORT OF THE DISASTER SURVEY TEAM ON THE EVENTS OF AGNES

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

On June 23, 1972, during the widespread floods that accompanied Hurricane Agnes, a disaster survey team was designated by the Administrator of the National Oceanic and Atmospheric Administration to review the effectiveness of NOAA's storm and flood warning services and to gather detailed first-hand information from the communities within the river basins effected by the flood events of Agnes. The field survey was completed by June 30. Since then, several reports concerning the flood disaster have been published, the principal one being 'The Agnes Floods--A Post-Audit of the Effectiveness of the Storm and Flood Warnings System of the National Oceanic and Atmospheric Administration, A Report for the Administrator of NOAA by the National Advisory Committee on Oceans and Atmosphere', November 22, 1972, Washington, D.C. The post-audit report is supported by NOAA's self-examination and self-analysis in this 'Final Report of the Disaster Survey Team on the Events of Agnes,' which was made available October 1972 in prepublication form and is now published as NOAA Natural Disaster Survey Report 73-1.

Pub. Feb. 73: 45p., Natural Disaster Survey Report 73-1, U.S. Dept. of Comm., NOAA.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0023, THE HOMEPORT STORY - AN IMAGINARY CITY GETS READY FOR A HURRICANE

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

This report presents practical advice on how a community can protect itself against a hurricane. Topics covered include pre-disaster planning, communications, shelter and public safety, and evacuation plans.

Pub. 1971: 22p., NOAA/PA 70028, U.S. Govt. Print. Office, Stock No. 0317-0046, Pk \$0.30.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0024, KENNEDY SPACE CENTER OCEAN BEACH EROSION - FLORIDA

A.J. MEHTA, Univ. of Florida, School of Engineering, Gainesville, Florida 32601

Abstract: Dune barrier erosion and possible breakthrough due to storm and hurricane wave activity is studied near Mosquito Lagoon, in Kennedy Space Center property. The results of a geological as well as hydrodynamic appraisal of the problem area indicate that no inlet has existed across the dune barrier since 500 A.D., and that there is little likelihood of a possible breakthrough inlet remaining open permanently, primarily because the relatively shallow lagoon does not contain enough volume of water to maintain an inlet between the ocean and the lagoon. It is therefore recommended that

Pub. Jun. 73: 66p., NTIS No. N73-33337/9, \$1.45.

SUPPORTED BY U.S. Natl. Aero. & Space A.

8.0025, BAL. HARBOUR, FLORIDA PARTIAL RESTORATION, BEACH EROSION CONTROL, HURRICANE PROTECTION PROJECT, DADE COUNTY, FLORIDA

UNKNOWN, U.S. Army, Engineer District, Jacksonville, Florida

Abstract: An 0.85-mile reach of the Dade County Beach Erosion Control and Hurricane Protection Project will be partially restored at Bal Harbour Beach for a public and recreational beach. Project fill would be an ocean borrow pit about 1.5 miles offshore and 10 to -36 to -50 feet. About 1.8 million cubic yards of sand dredged from an ocean borrow pit and placed on a one-mile reach of beach for restoration of protective assets. There will be some temporary turbidity in the borrow and fill areas during construction. Marine life will be destroyed; however, these areas are expected to become reestablished.

Pub. May 72: 55p., NTIS No. EIS-PL-72-5591-F, \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0026, EVACUATION OF COASTAL RESIDENTS DURING HURRICANES A PILOT STUDY FOR DADE COUNTY, FLORIDA

UNKNOWN, Miami Federal Executive Board, 33130

The concept of operations and background information contained in this document is to be incorporated as a part of Part D, Natural Disaster of the Dade County Emergency Operations Plan in 1973. It will become a plan of action for Metropolitan Dade County to handle emergencies insofar as the relocation and evacuation of endangered residents of Dade County is concerned.

This plan of operation represents the first phase of a study of a new concept for relocating coastal residents. It must leave their homes for safer refuge during emergencies. Its purpose is to augment, not to replace, existing concepts of public safety when a danger is about to make a land-fall. Agencies presently responsible for weather warnings and evacuation will also have to be involved in implementing the emergency refuge plan herewith. The primary objective of the new plan incorporated in this plan is to reduce the volume of traffic required for relocation of coastal residents. The length of time required to achieve relocation, and the number of places of emergency refuge for those persons who, for whatever reason, still remain in endangered locations. Evacuation routes have been cut off and normal routes can no longer be reached.

Pub. May 73: 48p., No copy info. available.

Abstract provided by FDAA.

SUPPORTED BY No Formal Support Reported

8.0027, ESTUARINE HYDROLOGY OF TAMPA BAY, FLORIDA
C.R. GOODWIN, U.S. Dept. of the Interior, Geological Survey, Tampa, Florida

A comprehensive hydrological investigation of Tampa Bay and its immediate surroundings is necessary to assess the probable effects of a proposed channel dredging project on the interacting hydraulic, chemical and biological systems operating in the bay. Unanswered technical questions concerning possible ground-water contamination, modified flushing and circulation characteristics, and overall environmental impact, as well as operational needs, such as quantity and placement of dredged material, justify this project.

The specific objectives of this study are: (1) bathymetric definition of the bay bottom, (2) determination of depth to bedrock, (3) definition of pollutant sources issuing into the bay and their subsequent distribution, (4) development of a management tool to predict the response of the bay to natural and man-made changes - dredging, filling, floods, hurricanes, etc., (5) determination of optimum channel alignment, quantity of material to be removed, and optimum location and shape of disposal sites.

The following techniques will be used to accomplish the listed objectives: (1) bay bottom mapping by negative-blue aerial photography and radar located sonic soundings, (2) depth to bedrock by low frequency sonar and core borings, (3) pollutant sources by detailed field survey, pollutant distribution by large scale water sampling program and best available laboratory analysis techniques, (4) a predictive management tool in the form of a digital model of the hydraulics and quality of Tampa Bay - verification by comparison with real data (velocity, elevation, quality), (5) optimum dredge operation and fill placement determined by using model to test all suggestions.

Fourteen tide gages operating; monthly and quarter QW monitoring programs established; Weather Bureau data being received monthly; bottom contour maps under topographic division review; digital model nearing completion of development period; data reports in preparation; 800 miles of depth data collected along ship channel and other areas.

Completion of stage, QW, seismic data reports; preparation of interpretive report; computation of types and quantity of material proposed to be removed from ship channel, completion of digital model; use of model to predict effects of proposed activities.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

8.0028, Jekyll Island, Georgia, Beach Erosion Control and Hurricane Protection

UNKNOWN, U.S. Army, Engineer District, Savannah, Georgia 31402

Abstract: The project proposes restoration and periodic nourishment of 27,000 feet of ocean beach and construction of a 1,000 foot rubblestone terminal groin. Environmental impacts include: Restoration and maintenance of ocean beach, stabilization of eroding shoreline, increased nesting sites for loggerhead sea turtles, enhancement of recreational facilities, improved economic prospects, and continued maintenance of island's aesthetics. Adverse environmental effects include: temporary increased water turbidity and disruption of benthic, plankton and nekton communities during construction; after project completion, probable increased mortality rate of young loggerhead sea turtles.

Pub. Aug. 73: 50p., NTIS No. EIS-GA-73-1315-D: PC \$4.50.

SUPPORTED BY U.S. Dept. of Defense - Army

Abstract: The manual states policy, outlines responsibilities, and prescribes procedures for providing weather and specialized forecast support to authorized units. AWS/DO is OPR for Volume I, which applies to units. AWS Forms 39 and 39a are prescribed in the manual. Pub. Oct. 71: 28p., NTIS No. AD-732 263: PC \$0.95

SUPPORTED BY U.S. Dept. of Commerce - NOAA

8.0030, Grand Isle, Louisiana, and Vicinity Hurricane Protection Associated with Bayou Lafourche - Louisiana

UNKNOWN, U.S. Army, Engineer District, New Orleans 70160

Abstract: The report describes the administrative construction of about 43 miles of exterior levee with associated borrow pits, drainage structures, appurtenances to provide protection from hurricanes along both banks of Bayou Lafourche from Larose 2 miles south of Golden Meadow, Louisiana. The project is located entirely in Lafourche Parish, Louisiana. Environmental impacts are discussed.

Pub. Sep. 72: 39p., NTIS No. EIS-LA-72-5427-D:

SUPPORTED BY U.S. Dept. of Defense - Army

8.0031, New Orleans to Venice, Louisiana Hurricane Protection

UNKNOWN, U.S. Army, Engineer District, New Orleans 70160

Abstract: The report describes the proposal for protection of the back levees from the City of New Orleans (approximately 36 miles) on the west bank of the Mississippi River, including a new floodgate at Empire and the construction of a new levee from Phoenix to Bohemia (approximately 10 miles) on the east bank. In addition, a hurricane protection levee is proposed for the Head of Passes on the west bank of Plaquemines Parish from hurricane protection to be built. Drainage capability and roadway are maintained within the project area. Environmental impacts are discussed.

Pub. Aug. 72: 34p., NTIS No. EIS-LA-72-5425-D:

SUPPORTED BY U.S. Dept. of Defense - Army

8.0032, Lake Pontchartrain, Louisiana Vicinity - Hurricane Protection Program

UNKNOWN, U.S. Army, Engineer District, New Orleans 70160

Abstract: The project is concerned with construction of levees, and hurricane protective works in the Saint Charles Parishes, Louisiana for the purpose of control and protection of lives and property. Efforts due to construction include destruction of many acres of wildlife habitat.

Pub. Apr. 72: 96p., NTIS No. EIS-LA-72-5174-O:

SUPPORTED BY U.S. Dept. of Defense - Army

8.0033, Morgan City, Louisiana, and Vicinity (Franklin and Vicinity Area)

UNKNOWN, U.S. Army, Engineer District, New Orleans 70160

stations will be modified, and drainage structures will be modified or replaced to meet increased levee grades. The project will effect a complete closure of the area to be protected. The project is located in St. Mary Parish, Louisiana. Significant environmental impacts in the project area are not anticipated. Other than additional borrow areas, the project will alter the existing terrain only to the extent of raising and strengthening the existing Federal levees, and the construction of 3.5 miles of new levee. The human environment will be enhanced by protection of life and property during hurricane flooding.

Pub. Jan. 73: 66p., NTIS No. EIS-LA-73-0989-F; PC \$5.50 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0034, HURRICANE PROTECTION PROJECT, STRATFORD, CONNECTICUT

UNKNOWN, U.S. Army, New England Division, Waltham, Massachusetts

Abstract: The low portions of Stratford, Connecticut, will be encircled by levees and floodwalls for protection against tidal flooding. No major adverse effects are anticipated. Some temporary or short-term effects to the biological makeup of the area may occur when the control gates are closed during periods of tidal flooding.

Pub. Dec. 71: 36p., NTIS No. PB-204 571-D; PC \$3.00.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0035, OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, MASSACHUSETTS

UNKNOWN, U.S. Army, New England Division, Waltham, Massachusetts

Abstract: The project proposes operation and maintenance of the main harbor barrier and dike and its related structures. Environmental impacts include protection to the highly developed commercial, industrial and residential areas from tidal flooding during major coastal storms and hurricanes; serves a protective facility for harbor-based and transient vessels; compressed air jetting which causes some temporary turbidity; rodent control. Rodent control and air jetting could be considered to have possible adverse effects.

Pub. Aug. 73: 37p., NTIS No. EIS-MA-73-1353-F; PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0036, OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, NEW BEDFORD, MASSACHUSETTS

UNKNOWN, U.S. Army, New England Division, Waltham, Massachusetts

Abstract: The New Bedford Barrier is located on the northwesterly side of Buzzards Bay, 50 miles southerly of Boston, Massachusetts. It extends for a total distance of approximately 3 1/2 miles across the southerly portion of the City of New Bedford and the Town of Fairhaven. The statement concerns the operation and maintenance of the main Harbor Barrier and Dike and its related structures.

Pub. Jun. 72: 31p., NTIS No. EIS-MA-72-4782-D; PC \$3.75.

SUPPORTED BY U.S. Dept. of Defense - Army

Abstract: Construction is proposed for a earth filled rock protected barrier for protection of the City of New Bedford from hurricane flooding. The impact of the barrier on a blighted area facing a valuable waterfront where manufacturing, open space, and shorefishing facilities could be restricted, and a temporary adverse impact from construction would result.

Pub. Jul. 71: 21p., NTIS No. PB-204 571-D; PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0038, GALVESTON BAY HURRICANE PROTECTION PROJECT 2, EFFECTS OF PROPOSED BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYSPNOEA (BREV)

W.H. BOBB, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The primary purpose of this study is the determination of the effects of proposed barrier schemes on tides, currents, salinities, and dysoxia throughout the bay complex for long-range planners in the Galveston Bay area. Among other things, freshwater inflows, generating plant cooling requirements, surge protection barriers for both flood and low water conditions. It is presently estimated that the regulations and diversion will be accomplished before the protection plan. Therefore, after the barrier is constructed, and dye dispersion tests to duplicate tests were made for diversions estimated for 1980.

Pub. Jul. 70: 144p., NTIS No. PB-204 571-D; PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0039, GALVESTON BAY HURRICANE PROTECTION PROJECT 3 - EFFECTS OF BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYSPNOEA (BREV)

W.H. BOBB, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: Hurricane protection barriers in the Galveston Bay area. A separate study of the barrier schemes would protect the bay from hurricane flooding. The plan 2 Gamma barrier crosses the bay at the mouth of the bay. Both schemes provide protection across channels and gated tidal passages. The barrier is located to maintain existing tides, currents, salinities, and dysoxia passages are expensive and slow. Tests for normal tides were made for the model for pre- and postbarrier conditions. The model for pre- and postbarrier conditions, salinities, and dispersion parameters.

Pub. Jul. 70: 111p., NTIS No. PB-204 571-D; PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0040, GALVESTON BAY HURRICANE PROTECTION PROJECT 4 - EFFECTS OF BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYSPNOEA (BREV)

Abstract: Design of barriers for protection of all or portions of Galveston Bay against inundation by hurricane surges required the use of hydraulic model studies of the Galveston Bay complex to verify the results of surge routings by analytical methods and to determine the effects of all proposed structures on normal tides and hurricane surge heights upstream and downstream from barrier sites. The Galveston Bay hurricane surge model reproduced the coast from Freeport on the south to High Island on Bolivar Peninsula on the east. The model included an average width of the Gulf of Mexico of about 25 miles, measured normal to the gulf, all of the barrier islands in the bay interior, including its many connecting arms, lakes, and lagoons; and the coastal area within this sector up to a maximum elevation of 20 ft msl; and reproduced normal tides as well as gulf surges created by hurricane forces. The model was of the fixed-bed type molded of concrete to linear scale ratios, model to prototype, of 1:100 vertically and 1,300 horizontally. Automatic tide generators reproduced normal tides and tidal currents throughout the model. Hurricane surges were reproduced by a horizontal-displacement type surge generator. Either of the two major hurricane protection plans tested would provide protection for the area inland from the barrier when the navigation openings were closed.

Pub. Sep. 69: 169p., NTIS No. AD-709 587. HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0041, WAVE AND SURGE CONDITIONS AFTER PROPOSED EXPANSION OF MONTEREY HARBOR, MONTEREY, CALIFORNIA - HYDRAULIC MODEL INVESTIGATION

C.E. CHATHAM, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: A 1:120-scale model of Monterey Harbor, California, and sufficient offshore area to permit generation of the required test waves was used to investigate the arrangement and design of certain proposed harbor improvements with respect to wave and surge action and to determine current conditions in the navigation entrances to the harbor and its basins. The proposed harbor improvements consisted of (a) enlarging the present harbor by construction of a detached north breakwater, approximately 3350 ft in length, and a companion east breakwater connected to shore and extending approximately 1100 ft seaward, and (b) development of the inner harbor area by constructing moles to form two additional basins for the anchorage of small pleasure craft. A 56-ft-long wave machine and electrical wave height measuring and recording apparatus were utilized in model operation. Base tests were conducted with existing prototype conditions installed in the model. Results of tests involving the various improvement plans were compared with base test results to determine the relative effectiveness of the various plans. An analytical study of long-period sea-energy oscillations in the vicinity of Monterey Bay with respect to the possibility of related response in Monterey Harbor was conducted, and the results of that study are presented in Appendix A.

Pub. Sep. 68: 125p., NTIS No. AD-723 954. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0042, WAVE AND SURGE ACTION MONTEREY HAR-

Abstract: The model study was conducted to determine the adequacy of certain proposed breakwater plans for Monterey Harbor from wave and surge action. In conjunction with the model study a prototype wave analysis was conducted to determine the characteristics of the waves which occur in the harbor.

Pub. Sep. 49: 76p., NTIS No. AD-756 399. PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0043, DISCHARGE CHARACTERISTICS OF PROPOSED HURRICANE BARRIERS, WAREHAM-MARION MASSACHUSETTS - HYDRAULIC MODEL INVESTIGATION

E.C. MCNAIR, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: Three, 1:25-scale, undistorted models were used to simulate hurricane barriers proposed for the Wareham and Marion Rivers and Onset Bay in the vicinity of Marion, Massachusetts. These structures will consist of (a) dikes protected by rock faces and toes and intermediate navigation openings at existing navigation openings. Discharge coefficients of the structures and the velocities occurring in the vicinity of the openings were determined for headwater (ocean) and tailwater (river) conditions ranging from 0.0 to 20 ft msl and -10 to 10 ft msl. The Onset Bay barrier, which will have gates to permit partial closure of the navigation opening to increase protection from hurricane surges, was investigated with the gates open and closed.

Pub. Oct. 64: 39p., NTIS No. AD-756 282. PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0044, DISCHARGE CHARACTERISTICS OF PROPOSED HURRICANE BARRIERS, EAST PASSAGE OF NARRAGANSETT BAY, RHODE ISLAND - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The discharge characteristics of the navigation opening (base width of 1500 ft) in the proposed hurricane barrier for the East Passage of Narragansett Bay, Rhode Island, were investigated by means of both section and three-dimensional models. Two section models, reproducing the barrier at scales of 1:50 and 1:150, were used to determine the effect of approach depth, roughness of the barrier, and width of the navigation opening on the discharge characteristics of the structure. A 1:150-scale, undistorted, three-dimensional model was used to determine the discharge characteristics of two weirs, one for both flood and ebb flows, and the effect of the spur dike on flood-flow characteristics. Basic data were presented graphically. An analysis of data was made to develop discharge equations applicable to both steady state flood and ebb flows were developed.

Pub. Apr. 65: 38p., NTIS No. AD-733 847. PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0045, GALVESTON BAY HURRICANE SURGE PROTECTION - EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS (ABBREVIATED)

ricane protection systems for the Galveston Bay, Texas, complex. Results of tests to define head losses associated with key portions of the complex are presented to serve as input to a mathematical model of the Galveston Bay area. Results of tests to define the head losses for normal tides and hurricane surge conditions for the Galveston Harbor Entrance and the barrier beaches associated with Galveston Bay are presented. Development of model structures to allow the effectiveness of two barrier plans (Alpha and Gamma) to be evaluated in a distorted-scale model (1:100 vertically and 1:3000 horizontally) is discussed. Model structures of a 400-ft-wide by .55 ft msl navigation opening for each plan and a gated opening with the top of the gate at plus 5 ft msl were developed.

Pub. Mar. 73: 65p., NTIS No. AD-759 119; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0046, GALVESTON BAY HURRICANE SURGE - REPORT (2) EFFECTS OF PROPOSED BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV)

R.A. SAGER, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The appendix is one of a series of reports presenting results of a model test program conducted to evaluate two proposed hurricane protection systems for the Galveston Bay, Texas, complex. Development of model structures to allow the effects of two barrier plans (Alpha and Gamma) on normal tide conditions to be evaluated in a distorted-scale model (1:60 vertically and 1:600 horizontally) is discussed. A model structure of a 400-ft-wide by .55 ft msl navigation opening was developed for each plan. Model structures of a total of 108 60-ft-wide tidal passages varying in depth from .10 to .40 ft msl were developed for the Alpha plan and a total of 160 60-ft-wide tidal passages at depths of .6 and .12 ft msl were developed for the Gamma plan.

Pub. Mar. 73: 51p., NTIS No. AD-759 120; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0047, PROTECTION OF NARRAGANSETT BAY FROM HURRICANE SURGES

H.B. SIMMONS, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The design of barriers for protection of Narragansett Bay against inundation by hurricane surges required use of a comprehensive model to determine the effects of proposed structures on normal tide and hurricane surge heights, current velocities, the salinity regimen of the bay, and the rates of diffusion and flushing of pollutants discharged into the bay. Model tests indicated that barriers should not be located in the central portions of the bay because of excessive build-up of surge heights downstream from such barriers, that a lower bay barrier alone could not satisfy the requirements of the Navy and at the same time afford the desired reductions in surge heights at upstream locations, but that the combination of a gated structure at Fox Point for the protection of Providence with a system of lower bay barriers with ungated openings could satisfy the requirements of the Navy for maximum current velocities and at the same time provide hurricane surge protection throughout the bay system.

8.0048, EFFECTS ON LAKE PONCHARTRAIN OF HURRICANE SURGE CONTROL MISSISSIPPI RIVER-GULF OUTLET

J.C. TALLANT, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: A system of barriers along the eastern end of Lake Pontchartrain as a plan for protecting New Orleans from a model study was conducted to determine barriers and also that of the Mississippi Channel (now under construction). The salinity regimen of Lake Pontchartrain was concluded that (a) freshwater equal consideration with any plan for salinity regimen of the lake system; (b) structures for Chef Menteur and Rigolette adverse effect on salinities and tidal height of the Gulf Outlet Channel to increase salinity in the lake such that be required.

Pub. Nov. 63: 113p., NTIS No. AD-759 121; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0049, THE USE OF GRASSES FOR STABILIZATION ALONG THE GULF COAST WITH EMPHASIS ON THE TEXAS COAST

T.W. BILHORN, Gulf Univ. Res. Center, Galveston, Texas 77550

Abstract: The Texas Gulf Coast is the most vulnerable because it is the most exposed 1622 miles of coast of the Gulf of Mexico. It provides significant protection from hurricane-generated waves, but violent storms 15-20 feet above sea level causing significant erosion. The sand does not have a vegetative or natural protective barrier to storm surge. A continuous vegetated dune system would be a continuous vegetated dune system above mean sea level.

Pub. Nov. 71: 67p., NTIS No. AD-759 122; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0050, VIRGINIA BEACH, VIRGINIA HURRICANE SURGE CONTROL AND HURRICANE PROTECTION

UNKNOWN, U.S. Army, Engineer District, Vicksburg, Mississippi 39180

Abstract: A hurricane protection and project is proposed, consisting of sheet pile concrete, raising and widening the beach, and the construction of certain non-structural measures in Virginia.

Pub. Sep. 72: 32p., NTIS No. EIS-VA-759 123; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

HAZARD REDUCION

8.0051, PRELIMINARY REPORT OF PROJECT II DATA (WAVE FORCES ON RIGID STRUCTURES) GULF OF MEXICO

F.M. BRIDGES, Univ. of California, San Diego, La Jolla, California 92037

order to attempt to analyze them using the statistical methods developed by Borgman (1967), and to try to obtain prototype information of the 'lift forces' associated with the formation of eddies. Here the term lift forces refers to the horizontal force normal to the direction of wave advance. The study presented herein is a preliminary attempt to analyze the wave force data measured during Hurricane Carla in 1961.

Pub. Jun. 71: 43p., NTIS No. AD-726 011: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0052, FURTHER VERIFICATIONS OF AND EXPERIMENTS TO IMPROVE THE MODIFIED HATRACK SCHEME FOR FORECASTING THE MOTION OF TROPICAL CYCLONES

S.G. COLGAN, U.S. Navy, Postgraduate School, Monterey, California 93941

Abstract: The modified hatrack (MODHATR) scheme for forecasting tropical cyclone motion consists of a numerical steering component using geostrophic winds derived from Fleet Numerical Weather Central's SR height field to steer the storm center, and a statistical modification component to correct for bias and improve forecast accuracy. MODHATR forecasts from the 1969 and 1970 North Atlantic hurricane seasons are analyzed, and average errors presented and compared to earlier years' results. MODHATR forecasts are shown to be superior on the average to OFFICIAL forecasts, NHC-67, and HATRACK forecast schemes for forecast intervals to 48 hours, with relative accuracy of MODHATR decreasing with time.

Pub. Sep. 71: 57p., NTIS No. AD-734 985: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0053, TROPICAL CYCLONE MOVEMENT FORECASTS BASED ON OBSERVATIONS FROM SATELLITES

R.W. FETT, U.S. Navy, Environ. Pred. Res. Facility, Monterey, California 93941

Abstract: A method to predict 24-hr movement of tropical cyclones using consecutive daily satellite views is described. The method is based on the observation that changes in the location of major structural features of the storm are correlated with changes in the direction of movement of storm centers. Major structural features appear to retain the same relative location with respect to the direction of movement of the storm center. The rotation of features noted in comparing satellite views over a 24-hr period is frequently found to approximate in sense and value the further deflection the storm will take in its track during the following 24 hours. A test evaluation of the method by seven individuals using 31 separate data sets of satellite data produced results significantly better than official 24-hr forecasts.

Pub. Jan. 74: 51p., NTIS No. AD-774 683/1: PC \$3.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0054, TROPICAL CYCLONE ENERGY TRANSFER

P. DERGARABEDIAN, T R W Incorporated, Redondo Beach, California 90278 (DAHC04-71-C-0025)

mate simulation models. Ability to predict quantitatively the effects of human intervention on individual weather systems or the planetary atmosphere essential to defense of united states interests.

The contractor will improve the formulation of an existing tropical cyclone model by more sophisticated treatment of the boundary layer, sea-atmosphere fluxes, thermodynamics, turbulence, and friction. Provision for changes in sea-surface condition and storm movement over land will be made. The model will be coded in optimum form for computer implementation.

Supporting agency address information: Defense Advanced Research Projects Agency, Arlington, Va. 22209

SUPPORTED BY U.S. Dept. of Defense - D.A.R.P.A.

8.0055, TROPICAL CYCLONES

F.E. FENDELL, T R W Incorporated, Redondo Beach, California 90278

Abstract: After a brief summary of salient observational facts about cumulus convection in the tropical ambient and about tropical cyclones, models for the cyclone-scale structure and maintenance of the quasisteady mature stage of a hurricane are presented and evaluated. Principal attention is devoted to the model developed by Riehl and Malkus in the late 1950's, and to the model developed by Carrier in the early 1970's.

Pub. Mar. 73: 179p., NTIS No. AD-757 084: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0056, THE EFFECTS OF HURRICANE CAMILLE ON INDUSTRY, PUBLIC UTILITIES, AND PUBLIC WORKS OPERATIONS

R.H. BLACK, U R S Systems Corporation, San Mateo, California 94402

Abstract: The report describes the results of an investigation and a site inspection of the industry along the Mississippi Gulf Coast following Hurricane Camille. The investigation covered public utilities; selected samples of the manufacturing, chemical processing, and food processing industries; and public works, including debris removal. The major topics covered during the interviews were hurricane plans and preparations, emergency actions during the hurricane, damage inflicted, and restoration activities. The results are examined from the viewpoint of their relationship to civil defense and restoration efforts following a nuclear disaster. Conclusions are drawn that relate to both hurricane and nuclear disasters. Recommendations are made on measures to reduce the effects of such disasters and on subjects warranting further study.

Pub. Mar. 70: 94p., NTIS No. AD-708 568: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0057, HURRICANE MODIFICATION

R.C. GENTRY, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302 (2G120144)

Research/service objective: To study the structure and energy processes in hurricanes to develop hypotheses for modification of tropical cyclones. To conduct field tests in hurricanes and conduct research on data collected to determine effectiveness of the experiments.

modification experiments. 2) To continue research on and evaluation of previous hurricane modification experiments. 3) To continue research to develop better means of evaluating hurricane modification experiments. 4) To seek better means of modifying hurricanes.

Progress report: Had successful field operations: 1) Cloud Line Seeding 2) Feasibility experiments for inhibiting convection with hydrophilic powders and for inhibiting evaporation from the ocean with a film. 3) Collecting of cloud physics information in tropical clouds. Developed improved model for simulating a hurricane. Obtained improved understanding of the rate and circumstances of energy transfer between the ocean and atmosphere in hurricanes.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0058, TROPICAL METEOROLOGIC PROBLEMS

R.C. GENTRY, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302 (21350223)

Technical objective: To conduct basic and applied research on hurricanes and other tropical weather phenomena by means of observational, analytical and theoretical studies.

Approach: 1) To continue basic studies for improvement of hurricane modeling techniques. 2) Research on structure and energy processes in hurricanes and other tropical systems. 3) To develop improved techniques for forecasting hurricane motion, formation and intensity. 4) Use research aircraft, satellites and other systems to collect specialized data.

Progress: Much effort has been directed toward analytical studies of hurricanes to improve hurricane modeling techniques. This research supports the improvements of techniques for forecasting hurricane motion, formation and intensity while also complementing the hurricane modification program.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0059, A PRELIMINARY VIEW OF STORM SURGES BEFORE AND AFTER STORM MODIFICATIONS

C.P. JELESNIANSKI, U.S. Dept. of Commerce, Weather Modification Prog. Off., Boulder, Colorado 80302

Abstract: Storm surges are computed numerically with a two-dimensional dynamic surge mode, before and after storm modifications. The driving forces used to generate the surges are derived from wind profiles, used here in two different forms. First, a continuous analytic form is used. Second, tabulated wind values from Doppler wind observations measured at 12,000 ft altitude are used: these winds are incremented at 1 n mile intervals from the storm's center. The resulting computations imply that the peak surge on the open coast is not always monotonically related to the parameter, maximum wind speed of the storm. In fact, with the analytic wind profile, the peak surge may increase or decrease according to the manner in which the other storm parameters are affected by the change in maximum wind speed. From the tabulated wind profiles, it is found that the shape of the wind profile has an effect on the peak surge and is separate from the effects of maximum wind, pressure drop, and size scale.

Pub. May 73: 38P., NTIS No. COM-73-11304/5: PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0060, STORM SURGE RESEARCH

F. OSTAPOFF, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302 (2C692244)

tant physical processes leading to storm surge. Research/service plan: To assess the present surge research in the U.S. and to begin friction.

SUPPORTED BY U.S. Dept. of Commerce

8.0061, HURRICANE RESEARCH MODEL

S.L. ROSENTHAL, U.S. Dept. of Commerce, Research Laboratories, Boulder, Colorado 80302 (2C692244)

Research/service objective: To develop improved models of hurricanes and other tropical cyclones to be used in studying hurricanes, and in predicting hurricane motion and hurricane intensity.

Research/service plan: 1. To develop hurricane models (symmetric and asymmetric) which include cloud physics parameterizations and numerical schemes. To use these models to increase our knowledge of hurricane processes and our ability to predict hurricane intensity.

Progress report: Developed improved parameterizations of cloud physics for the symmetrical hurricane model and numerical schemes used in the asymmetric hurricane model.

SUPPORTED BY U.S. Dept. of Commerce

8.0062, HURRICANE MODELING

S.L. ROSENTHAL, U.S. Dept. of Commerce, Research Laboratories, Boulder, Colorado 80302 (2C692244)

Research/service objective: To develop improved models of hurricanes and other tropical cyclones to be used in studying hurricanes, and in testing hurricane modification hypotheses.

Research/service plan: 1. To develop hurricane models (symmetric and asymmetric) which include cloud physics parameterizations and numerical schemes. To use these models to simulate more realistic hurricane modification experiments.

Progress report: Developed improved parameterizations of cloud physics for the symmetrical hurricane model and numerical schemes used in the asymmetric hurricane model. In developing a full 3-dimensional hurricane model.

SUPPORTED BY U.S. Dept. of Commerce

8.0063, HURRICANE-TYPHOON DYNAMICS

M. SCHERER, U.S. Dept. of Commerce, Research Laboratories, Boulder, Colorado 80302 (2C692244)

Research/service objective: Determine outer boundary thermodynamic characteristics of typhoons and develop a new global view of tropical cyclones.

Research/service plan: Composite rawinsonde observations around typhoons, hurricanes and tropical cyclones, actual and relative rectilinear and cylindrical coordinates to the centers of tropical cyclones. Climatological data from new Navy and Asheville generated data to develop a new cyclone prediction scheme to the tropical belt for developing a reasonably good model of cyclone genesis.

SUPPORTED BY U.S. Dept. of Commerce

8.0064, HURRICANE-OCEAN INTERACTIONS

M. SCHERER, U.S. Dept. of Commerce, Research Laboratories, Boulder, Colorado 80302 (2C692244)

Research/service objective: Develop a simple coupled ocean-atmosphere model that will predict the dependent behavior of the hurricane and the ocean.

Research/Service plan: An improved hurricane boundary layer will be developed to study the response of the hurricane to specified oceanic parameters such as surface temperature and wave structure. The boundary layer model will include about 10 layers and utilize exchange coefficients for heat, moisture and momentum that vary with stability, wind shear, and wave geometry. After development of a satisfactory boundary layer model, a simple stratified two-layer ocean model will be developed and allowed to interact with the hurricane.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0065, SEA-AIR INTERACTION LABORATORY OPERATIONS

H.B. STEWART, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302 (023822143)

Technical objective: Development of mathematical models of the energy exchange processes between the ocean and atmosphere for improved understanding and prediction of oceanic and atmospheric conditions.

Approach: A major effort involves direct investigation of the diurnal and higher frequency energy exchanges as based on the total heat budget of the ocean mixed layer. Instrumented buoys will be monitored during a three week drift period in the vicinity of Puerto Rico. Laboratory (wind/wave tank) studies will examine the interface processes, specifically very near the surface. Development of instrumentation and field studies of irradiance levels within the ocean, and at and immediately above it in the atmosphere will continue. Remote sensing techniques offer considerable potential for rapid surveillance of large ocean areas influenced by tropical and extratropical storms. Measurement of wave heights, energy fluxes, surface water temperatures, etc., will be continued in cooperation with the RFF.

Progress: Field tests of the instrumented buoys for the mixed layer project near Puerto Rico have been made, and final checkout of equipment and numerical models for data analyses are nearing completion. Excellent results have been obtained from initial wind/wave tank tests utilizing hydrogen bubbles near the surface as water movement tracers. Radiation measurements at several water depths have proven satisfactory in tests near Bimini, as have remote sensing of the sea surface using the RFF aircraft as platforms.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0066, INVESTIGATION OF SATELLITE OBSERVED TYPHOON-HURRICANE CLOUD CLUSTERS AND FLOW FEATURES

W.M. GRAY, Colorado State University, School of Engineering, Fort Collins, Colorado 80521 (263211162)

Technical objective: To develop better understanding of the tropical synoptic and meso-scale cloud clusters that are associated with tropical cyclones.

Approach: The approach will be similar to that already employed by C.S.U. in their study of tropical meso-scale cloud clusters not associated with tropical storms. Storms will be stratified by intensity, stage of development, movement, etc. Groups of storms will then be studied using satellite picture data in conjunction with rawinsonde data. The compositing technique again will be employed, and the study will concentrate on the Caribbean and Western North Pacific regions where the rawinsonde data are most plentiful.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

The objective of this research is fundamental knowledge by means of observational and modeling studies on the dynamics of cumulus convection, with particular emphasis on the relation of cumulus convection to the (a) general circulation, (b) the tropical cloud cluster, (c) severe weather, (d) the hurricane's eye wall, and (e) the CISK idea of boundary layer frictional forcing. Most of this research will be directed towards answering the dynamic questions required for the successful planning and carrying out of the GATE program in 1974, and to a number of the physical problems concerned with cumulus convection in the general circulation which will be encountered in later GARP research.

SUPPORTED BY U.S. Natl. Science Foundation

8.0068, HURRICANE SPAWNED TORNADOES

D.J. NOVLAN, Colorado State University, School of Engineering, Fort Collins, Colorado 80521

Abstract: An updated climatology of hurricane spawned tornadoes is presented from information gathered for U.S. cases from 1948-72 and typhoon induced tornadoes over Japan from 1950-71. The paper presents a qualitative tornado genesis model which attempts to demonstrate the crucial importance of large low level vertical wind shear in the genesis mechanism. A forecasting guide is also given. The most important difference between storms which produce tornadoes and those which do not is a very large increase of the vertical shear of the horizontal wind between the surface and 4-5 thousand feet. This averages about 40 knots for the tornado cases, but is much less in the cases which do not produce tornadoes.

Pub. May 73: 64p., NTIS No. COM-73-11296/3; PC \$5.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0069, THE STRUCTURE AND DYNAMICS OF THE HURRICANE'S INNER CORE REGION

D.J. SHEA, Colorado State University, School of Engineering, Fort Collins, Colorado 80521

Abstract: Observational information from approximately 100 flight missions (533 radial legs) flown into twenty-one hurricanes on forty-one storm days over a thirteen year period by aircraft of the NOAA's Research Flight Facility is used to present a unified view of the structure, dynamics, and variability of the hurricane's inner core region. Most flight missions were made between the 900 and 500 Mb levels. Utilizing this information, a steady state schematic model of the mean flow conditions in the hurricane's inner core region is presented. The variability of the inner core meteorological parameters of wind speed, radius of maximum wind, inner radar radius and equivalent potential temperature is discussed. Wind-pressure acceleration balance information is shown. An estimate of the effect water motion has on the Doppler measured winds is made.

Pub. Apr. 72: 144p., NTIS No. COM-72-10683; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0070, STATISTICAL PREDICTION OF HURRICANE STORM SURGE - SOME MATHEMATICAL CONCEPTS RELATED TO STOCHASTIC SPECTRUM ANALYSIS (ABBREV)

C.Y. YANG, Univ. of Delaware, School of Marine Science, Newark, Delaware 18711

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0071, A SURVEY OF AVAILABILITY OF HURRICANE/TYPHOON PACKAGES AND ASSOCIATED DATA**A.R. MEALS**, U.S. Air Force, Environ. Tech. Appl. Center, Washington, District of Columbia

Abstract: The survey outlines the types and format of data available on tropical cyclones. The emphasis is on data packages assembled for individual storms. A list of sources for currently available packages is provided. In addition, a catalog of data archived at National Climatic Center, Asheville, North Carolina, and a bibliography of long-term tropical storm climatology are provided.

Pub. Jan. 72: 20p., NTIS No. AD-736 451. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0072, STORM SURGE ON THE OPEN COAST - FUNDAMENTALS AND SIMPLIFIED PREDICTION**B.R. BODINE**, U.S. Army, Coastal Engin. Res. Center, Washington, District of Columbia 20016

Abstract: A quasi-two-dimensional numerical model for open-coast storm-surge computations is discussed from the standpoint of underlying assumptions, range of validity, calibration, and application. While it is possible to make computations manually, electronic digital calculations are generally preferred. Elementary aspects of hurricanes and the physical factors of storm-generation processes are discussed. The basic hydrodynamic equations are given, together with the assumptions generally made in their development. The equations consistent with the model are reduced forms of the basic equations in which several terms have been neglected. These omissions are indicated, and their effects on the resulting numerical scheme are discussed. The use of design hurricanes for engineering studies is treated. Effects of astronomical tide, initial water level, and atmospheric-pressure setup are considered. A problem is solved for the Chesapeake Bay Entrance by computer and manually. The computer program used is listed.

Pub. May 71: 65p., NTIS No. AD-728 128. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0073, LONG-PERIOD WAVES AND SURGES**UNKNOWN**, U.S. Army, Coastal Engin. Res. Center, Washington, District of Columbia 20016

Purpose of study/investigation: To gain an improved understanding of the creation, propagation and transformation of long waves, particularly tides, storm and hurricane surges, and tsunamis.

Approach or plan: Research and development on long-period waves and surges including theoretical, laboratory, and field studies of surging in harbors; the prediction of changes in tidal currents and heights caused by changes in channels and basins; the prediction of storm surge heights at coastal locations; and the generation, travel, and effects of tsunami

dies on storm surge calculations including gravity waves by Texas A and M University. A mathematical storm surge model for coastal waters in Lake Okeechobee was formulated and implemented as a computer program, and Hillsborough County, Florida, model is being verified by the University. Three reports pertaining to tsunami studies are being prepared from the University of California. Studies on long waves by Texas A and M University are being completed. Final report and six earlier reports and journal articles.

SUPPORTED BY U.S. Dept. of Defense

8.0074, HURRICANE CAMILLE - AUGUST 1969**R.D. DIKKERS**, U.S. Dept. of Commerce, Gulf of Mexico Div., Washington, District of Columbia 20540

Abstract: One week after Hurricane Camille struck the Mississippi-Louisiana Gulf Coast with 125 mph winds, on August 17, 1969, a four-man team conducted a survey of the damage to buildings and other structures. Data on wind speed and storm surge, and recommendations and suggestions are made pertaining to the improvement of design and construction practices.

Pub. Mar 71: 73p., NTIS No. COM-74-100. PC \$1.45.

SUPPORTED BY U.S. Dept. of Commerce

8.0075, A TECHNIQUE FOR THE FORECASTING OF TROPICAL CYCLONES FROM SATELLITE PICTURES**V.F. DVORAK**, U.S. Dept. of Commerce, Satellite Serv., Washington, District of Columbia 20540

Abstract: A technique for using satellite pictures of tropical cyclones is described in detail. The technique is given for detecting changes in cyclone intensity, estimating the magnitude of the intensity, and for predicting hourly intensity changes. A code for training and testing is also described.

Pub. Jun 72: 22p., NTIS No. COM-72-100. PC \$0.95.

SUPPORTED BY U.S. Dept. of Commerce

8.0076, HURRICANE EFFECTS ON PORT FACILITIES**R.D. MARSHALL**, U.S. Dept. of Commerce, Office of Standards, Washington, District of Columbia 20540

Reasons for starting or progress last year: The U.S. Gulf Coast ports from 1965 to 1970 have received an estimated \$2 million per year for port facilities. In two of those years was on the order of \$1 million. The improvement of building codes, design criteria, and precautions to reduce hurricane damage to port facilities is of basic data on wind pressure and structural loads, and therefore essential that measurements of wind and wind loads on port facilities along the Gulf Coast be made and this information is

response measurements during the FY74 hurricane season.
SUPPORTED BY U.S. Dept. of Commerce - Maritime Administration.

8.0077, DESIGN, SITING, AND CONSTRUCTION OF LOW-COST HOUSING AND COMMUNITY BUILDINGS TO BETTER WITHSTAND EARTHQUAKES AND WIND-STORMS

H.F. REPS, U.S. Dept. of Commerce, Center for Building Technology, Washington, District of Columbia 20234

Abstract: The report provided technical information regarding characteristics of materials and building systems, and discusses the structural performance of buildings subjected to the action of earthquakes and wind forces with specific reference to structures typical of developing countries. Potential ways are described in which structures can be made more resistant to such action. Siting considerations are discussed from a geological, seismic and climatological viewpoint, and recommendations relating to siting problems are made. Techniques of housing construction, both traditional and industrialized, are described and improvements resulting in better earthquake or windstorm resistance are suggested. Building codes, their improvement and their enforcement are also discussed.

Pub. Jan 74: 153p., NTIS No. Com-74-50184/2: PC-GPO MF \$1.45-NTIS.

SUPPORTED BY U.S. Dept. of Commerce - N.B.S.

8.0078, WIND AND SURGE DAMAGE DUE TO HURRICANE CAMILLE

H.C. THOM, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234

Abstract: Wind speeds along the Gulf Coast during the passage of Hurricane Camille on August 17, 1969, are discussed. The severity of the storm is described in terms of the mean recurrence interval for tide heights at Biloxi, Mississippi. These evaluations of wind and storm surge intensity are then related to the distribution of structural damage in the area bounded by Biloxi and Bay St. Louis. It is concluded that provisions for storm surge should be included in future regional building codes and that good design practice and construction details can substantially reduce wind damage.

Pub. 1971: 9p., NTIS No. COM-72-50573.

SUPPORTED BY U.S. Dept. of Commerce - N.B.S.

8.0079, REPORT ON EARTHQUAKE INSURANCE TO CONGRESS OF UNITED STATES - PURSUANT TO SECTION FIVE OF SOUTHEAST HURRICANE DISASTER RELIEF ACT 1965

UNKNOWN, U.S. Dept. of Hou. & Urb. Dev., Fed. Insurance Administration, Washington, District of Columbia 20410

Abstract: Although California and Alaska are more vulnerable to earthquakes than other States, all but a few have experienced some earthquake activity. A severe earthquake in a densely populated area could cause heavy loss of life and billions of dollars of property damage. Earthquake insurance is readily available on one to four family dwellings throughout the United States. Earthquake insurance premiums on dwelling properties are neither excessive nor unreasonable. Earthquake insurance on commercial and industrial properties is available, but its availability is limited

Pub. 1971: 120 p., NTIS No. PB - 206 791: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

8.0080, ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME I - 24 HOUR MOVEMENT

H.L. CRUTCHER, U.S. Navy, Weather Service Command, Washington, District of Columbia 20301

Abstract: Probabilities relating to the future movement of North Atlantic tropical cyclones are presented. The probabilities are based on observational data of successive 12-hour positions of the centers of these storms. The data are stratified into five seasons (June-July, August, September, October, November-May) and into geographical areas defined by five-degree latitude-longitude squares. The probabilities are computed assuming the initial storm position or 'origin' is always at the center of the square and the target areas are always circular areas with radii of one, two and three degrees latitude which are also located at the center of the squares. These probabilities indicate the chance of the storm center being within the target areas at the end of specified time intervals. Two sets of probabilities are presented for each square: one set for the case when the origin is at the center of the master square, and a second set for the case where the target areas are centered on this square. Values for time intervals of 24 hours are presented in Volume I.

Pub. Aug. 71: 66p., NTIS No. AD-744 916: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0081, ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME II - 48 HOUR MOVEMENT

H.L. CRUTCHER, U.S. Navy, Weather Service Command, Washington, District of Columbia 20301

Abstract: Probabilities relating to the future movement of North Atlantic tropical cyclones are presented. The probabilities are based on observational data of successive 12-hour positions of the centers of these storms. The data are stratified into five seasons (June-July, August, September, October, November-May) and into geographical areas defined by five-degree latitude-longitude squares. The probabilities are computed assuming the initial storm position or 'origin' is always at the center of the square and the target areas are always circular areas with radii of one, two and three degrees latitude which are also located at the center of the squares. These probabilities indicate the chance of the storm center being within the target areas at the end of specified time intervals. Two sets of probabilities are presented for each square: one set for the case when the origin is at the center of the master square, and a second set for the case where the target areas are center on this square. Values for time intervals of 48 hours are presented in Volume II.

Pub. Aug. 71: 100p., NTIS No. AD-744 917: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0082, ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME III - 72 HOUR MOVEMENT

bilities are based on observation data of successive 12-hour positions of the centers of these storms. The data are stratified into five seasons (June-July, August, September, October, November-May) and into geographical areas defined by five-degree latitude-longitude squares. The probabilities are computed assuming the initial storm position or 'origin' is always at the center of the square and the target areas are always circular areas with radii of one, two and three degrees latitude which are also located at the center of the squares. These probabilities indicate the chance of the storm center being within the target areas at the end of specified time intervals. Two sets of probabilities are presented for each square: one set for the case when the origin is at the center of the master square, and a second set for the case where the target areas are centered on this square. Values for time intervals of 72 hours are presented in Volume III.

Pub. Aug. 71. 121p., NTIS No. AD-744 918; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0083, HURRICANE PREPAREDNESS AND CONTROL PLAN

UNKNOWN, U.S. Natl. Aero. & Space Adm., John F. Kennedy Space Center, Cocoa Beach, Florida

Abstract: This plan establishes policy and sets forth guidance, responsibilities and procedures utilized by Federal Electric Corp., communications department in support of the KSC Emergency Preparedness Plan, Annex A, Hurricane Control Plan (GP-355) dated 27 May 1971. This plan covers all FEC communications department personnel, facilities, and equipment situated at the Kennedy Space Center that are the responsibility of FEC contract NAS 10-4967.

Pub. May 72: 53p., NTIS No. N72-32605; PC \$4.75 MF \$0.95.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

8.0084, ATLANTIC TROPICAL SYSTEMS OF 1972

N.L. FRANK, U.S. Dept. of Commerce, Natl. Hurricane Center, Miami, Florida 33124

Abstract: The 1972 hurricane season produced 113 'seedlings' of which 24 acquired the closed circulation of a depression. This was the largest number of tropical systems observed since the National Hurricane Center began keeping records in 1968. The reason for this high number was the unusual development of many subtropical cyclones in temperate latitudes. Details are given on the census of 1972 tropical storms and a comparison with other years is made. During the 5 year period 1967-71, approximately 75% of the named storms and depressions were initiated by seedlings of the tropical type and only 25% by baroclinic seedlings. The opposite was true in 1972 with 75% of the depressions and storms spawned by the baroclinic seedlings. In a normal year, African systems initiated approximately half of the Atlantic storms and depressions. In 1972, however, only one storm (Dawn) and only six of the 24 depressions came from this source.

Pub. Feb. 73: 6p., NTIS No. COM-73-50496-04-04.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0085, HURRICANE DEBBIE MODIFICATION EXPERIMENTS, AUGUST 1969

R.C. GENTRY, U.S. Dept. of Commerce, Natl. Hurricane Res. Lab., Miami, Florida 33124

intervals on 18 and 20 August. The first intervals on 18 and 20 August, the maximum speed of winds at 3600 was 182 kilometers per hour, but, 5 hours after seeding, these winds decreased to 126 kilometers per hour. On 20 August, the corresponding change was from 156 kilometers per hour. Analyses of the data suggest the storm was modified.

Pub. 1970: 5p., NTIS No. AD-722 991; Reprint.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0086, COMPUTER METHODS APPLIED TO ATLANTIC AREA TROPICAL STORM AND HURRICANE CLIMATOLOGY

J.R. HOPE, U.S. Dept. of Commerce, Natl. Weather Center, Miami, Florida

Abstract: Tropical cyclone advisories and bulletins for the Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico are coordinated through the National Hurricane Center of the National Weather Service. Relevant to this project is the maintenance of suitable documentation of tropical cyclone tracks. Such data are stored on computer tape and can be instantly processed by a digital computer. With the data now stored on tape, the National Hurricane Center, using fully computerized methods, has the capability of quickly consulting the climatology of areas of any such portions of the hurricane season as may be pertinent to a particular forecast problem or for long-range planning purposes. The HURRICAN technique, an analog process routinely used as a basic forecast aid, is discussed.

Pub. 1971: 8p., NTIS No. COM-71-90037-05-2.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0087, OBJECTIVE ANALYSIS OF SEA SURFACE TEMPERATURES (SST)

B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Hurricane Center, Miami, Florida 33124

Objective: To give the hurricane forecaster objectively analyzed sea surface temperature and anomaly charts in real time for 3-day, 10-day, and 30-day periods during the 1974 hurricane season.

Current status: Results from the hurricane season of 1973 indicate that the objective analysis of the SST and identification of anomalies can give the hurricane forecaster regions in which a tropical cyclone can form and the warm SST which can be sources of energy for intensification.

Plan for FY-74: The objective analysis of the SST will be done on an operational basis for 3-day, 10-day, and 30-day periods.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0088, CIRCULATION FEATURES OF TROPICAL CYCLONES

B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Hurricane Center, Miami, Florida 33124

Objective: To compute several dynamic quantities so that the hurricane forecaster will be better able to determine the development potential of a tropical cyclone.

Current status: Objective analysis of the ATOLL (and the Tropical Oceanic Lower Layer) and 200 millibar wind speed enable the computation of the following in real time: 1) ATOLL and 200Mb vorticity and divergence. 2) ATOLL and 200Mb vorticity advection. 3) At selected points

ATOLL and 200Mb. a) Line integrals of the radial wind. b) Line integrals of the tangential wind. c) Flux of angular momentum. 4) Tendencies of the various quantities listed in 1, 2, and 3. These quantities can be computed twice daily depending on availability of computer time.

Plans for FY-74: These quantities will be computed twice daily when requested by the hurricane forecaster.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0089, PREDICTION OF HURRICANE DEVELOPMENT AND MOVEMENT WITH A BAROCLINIC MODEL

B.I. MILLER, U.S. Dept. of Commerce, Natl. Hurricane Center, *Miami, Florida 33124*

Objective: To improve the prediction of hurricane tracks, development, and rainfall associated with tropical weather systems by the application of a limited-area fine-mesh primitive-equation model.

Current status: Model has reached the stage where a few quasi-operational forecasts may be made during the 1973 hurricane season.

Plans for FY-74: Evaluate the results of the forecasts made during the 1973 hurricane season. Collaborate with NMC in the development of First Generation Model to be tested in 1974.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0090, GRAPHICAL DISPLAY OF HURRICANE FORECASTS

C.J. NAUMANN, U.S. Dept. of Commerce, Natl. Hurricane Center, *Miami, Florida 33124*

Objective: Develop a series of programs for the NMC VARIAN computer system to assist the hurricane forecaster in the mechanics of constructing a forecast hurricane track and keeping the track within the bounds of the 50 percent probability ellipses.

Current status: A program has been written for both the CDC 6600 and the NMC VARIAN computers to graphically display hourly forecast position and motion given the following initial conditions: (1) Starting latitude and longitude. (2) Two or more additional anchor points without regard to time. (3) A forecast storm speed at one or more of the standard forecast times. (4) Elliptical data.

Plans for FY-74: To develop additional programs for the VARIAN computer. Such programs will be designed to assist the hurricane forecaster in the mechanics of issuing and monitoring all aspects of the hurricane forecast problem.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0091, STATISTICAL DYNAMICAL PREDICTION OF HURRICANE TRACKS

C.J. NEUMANN, U.S. Dept. of Commerce, Natl. Hurricane Center, *Miami, Florida 33124*

Objective: To improve current statistical displacement forecasts using predictors derived from prognostic charts produced by NMC.

Current status: Using the so called 'perfect-prog' approach, fifty-two sets of statistical prediction equations have been developed for the Atlantic area tropical cyclone belt. Input data consists of the usual persistence and climatological data plus predictors derived from the current 1000, 700 and 500Mb analyses and the PE 24, 36 and 48 forecasts of the 500Mb level.

progs will be accomplished by introducing random errors (using Monte Carlo techniques) to the observed 'perfect-prog' data. In this way it is believed the screening regression program will assign more realistic weights to the prognostic data.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0092, ERROR ANALYSIS OF HURRICANE FORECASTS

J.M. PELISSIER, U.S. Dept. of Commerce, Natl. Hurricane Center, *Miami, Florida 33124*

Objective: To provide the hurricane forecaster with some objective means of evaluating the expected errors of the various prediction systems in operational use at NHC.

Current status: The errors of the four statistical tropical cyclone prediction systems in operational use at NHC (HUR-RAN, CLIPER, NHC67 and NHC73) have been found to be a function of the storm's initial U and V components of motion and its current position. This function has been approximated by a second-order polynomial fitted to the dependent data errors of least squares techniques.

FY-74 Plans: Complete the system of equations described above and extend the error analysis to the SANBAR barotropic model. Explore the feasibility of using Monte Carlo methods to extend the error analysis to independent data.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0093, BAROTROPIC PREDICTION OF HURRICANE TRACKS

A.C. PIKE, U.S. Dept. of Commerce, Natl. Hurricane Center, *Miami, Florida 33124*

Objective: Accurate prediction of tropical storm and hurricane tracks to three days with a filtered barotropic model. Initial data are winds averaged with respect to mass through the troposphere.

Current status: A careful initial analysis technique insures that each storm begins to move with an observationally specified direction and speed. With this method the model performs, on the average, at least as well as the official forecasts.

Plans for FY-74: Time-dependent boundary conditions will be tested. The initial analysis will be further refined. More satellite wind data will be incorporated.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0094, LANDFALL ERRORS IN HURRICANE FORECASTS

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Hurricane Center, *Miami, Florida 33124*

Objective: To enable the hurricane forecaster to determine in real time which of the statistical and numerical models is performing the best by application of Bayesian statistics.

Current status: The landfall program has been programmed to run on the 6600 computer and the VARIAN computer at NMC.

Plans for FY-74: Program will be run whenever a tropical storm or hurricane exists.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0095, PROJECT STORMFURY ANNUAL REPORT 1971 UNKNOWN, U.S. Dept. of Commerce, Natl. Hurricane Res. Lab., *Miami, Florida 33124*

Abstract: Stormfury is a program to study the effects of

Pub. Jun. 72: 185p., NTIS No. COM-73-10277; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

8.0096, HURRICANE MODIFICATION BY CLOUD SEEDING

M.A. ESTOQUE, Univ. of Miami, School of Marine Science, Miami, Florida 33149

Abstract: A theoretical model which is suitable for studying the effects of artificial cloud seeding on hurricanes is described. The model is based on the time-dependent, nonlinear, and axially symmetric primitive equations. It incorporates the effects of cloud microphysical processes and predicts explicitly the distribution of water in clouds and in precipitation. Artificial seeding is simulated in the model by freezing a specified percentage of the total liquid water content and then releasing the heat of fusion. Results of seedings at three different radial locations are discussed. Seeding produces an intensification of the storm in the earlier stages; but, subsequently, the seeded hurricane becomes weaker than the unseeded one. The largest modification occurs when seeding is nearest the eyewall.

Pub. Feb. 72: 39p., NTIS No. COM-72-10856; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0097, GIANT WAVES HIT HAWAII

J. BOTTOMS, U.S. Dept. of Commerce, Natl. Weather Service, Honolulu, Hawaii 96812

Abstract: The report describes the successful prediction of the arrival time of storm-generated heavy waves in Hawaii during early December 1969.

Pub. Sep. 70: 46p., NTIS No. COM-71-00021; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0098, USE OF SATELLITE DATA IN STUDIES OF TROPICAL DISTURBANCES

T. MURAKAMI, Univ. of Hawaii, School of Arts, Honolulu, Hawaii 96822 (263211413)

Objective: To improve understanding of large-scale tropical disturbances through theoretical and synoptic studies using meteorological satellite data.

Approach: A diagnostic model for the study of large-scale waves in a conditionally unstable tropical atmosphere has been developed. This model is an improved version of an earlier one and now includes a divergent wind component as well as frictional effects in the planetary boundary layer which play a dominant role in enhancing Rossby waves in the equatorial stratosphere. The model will be used to study many types of tropical disturbances and their relation to the large-scale circulation. This will include a study of the relation between fluctuations in monsoon rainfall and the strength of the jet stream. In addition, the relation between ocean temperatures and tropical convection and circulation will be examined. A parallel study will simulate the planetary-scale stratospheric temperature changes described by Fritz and Soules.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0099, THEORETICAL ANALYSIS OF LARGE-SCALE TROPICAL DISTURBANCES

T. MURAKAMI, Univ. of Hawaii, School of Arts, Honolulu, Hawaii 96822 (263211413)

mosphere. The following topics will be addressed: (a) the nature of large-scale disturbances in a conditionally unstable atmosphere. The following problems will be addressed: (a) the nature of the divergent meridional wind component; (b) sensitivity of structural waves in a free atmosphere due to the divergent meridional wind component; (c) wind and pressure perturbation in the boundary layer. 2. Numerical experiments of tropical disturbances forced by diabatic heating. The following topics will be addressed: (a) the nature of tropical disturbances as indicated by their growth and their ensuing periods and phase; (b) the energy required for equatorial disturbances; (c) the energetic processes of waves their energy; (d) the change in wave number in accordance with the development of the disturbance. 3. Numerical experiments of stratospheric disturbances. An attempt will be made to simulate the occurrence of the warming at 50-60N-50S. The sensitivity of the cross-equatorial zonal wave number asymmetry to the zonal wave number asymmetry will be investigated.

SUPPORTED BY U.S. Natl. Science Foundation

8.0100, PROPOSED CHARACTERIZATION OF TORNADOES AND HURRICANES BY THEIR INTENSITY AND AREA

T.F. FUJITA, Univ. of Chicago, School of Earth and Atmospheric Sciences, Chicago, Illinois 60637

Abstract: The research paper provides a proposed characterization of tornadoes by their intensity and area. A test characterizing tornadoes in 1950-69 was accomplished. 893 U.S.A. tornadoes in 1965. The intensity and individual area of U.S. tornadoes is very similar except for large and small tornadoes. It was found that the F-scale variation along the path of tornadoes showed an intensity oscillation. Characterization of hurricane intensity and area. Average typhoons are more intense than average hurricanes.

Pub. Feb. 71: 53p., NTIS No. COM-71-00021; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0101, PROBABILISTIC MODELS OF ENVIRONMENTAL LOADS

P.K. BEN, Univ. of Illinois, School of Civil Engineering, Urbana, Illinois 61801

This project deals with probabilistic models of extreme environmental loads caused by hurricanes and earthquakes. The physical processes which cause these loads are modeled by random processes. The mathematical formulation and the occurrence of these loads are modeled by random processes. The model is suitable for practical applications.

SUPPORTED BY University of Illinois

8.0102, PROBABILISTIC ANALYSIS OF PLASTIC STRUCTURES

T.L. PAEZ, Purdue University, School of Civil Engineering, West Lafayette, Indiana 47907

large loads occur, the behavior of most structures is nonlinear and often results in plastic deformations. Because excessive deformations could cause a structure to fail, it is important to study the structural response beyond the linearly elastic range by applying probabilistic methods in the solution of structural engineering problems. A method is presented for computing the first-passage probabilities for linear and nonlinear structures. In addition, the probability distributions of accumulated plastic deformation and permanent set in elasto-plastic structures are found. Several numerical examples are also given.

Pub. Aug. 73: 81p., NTIS No. PB-223 328/6; PC \$3.75 MF \$1.45.

SUPPORTED BY U.S. Natl. Science Foundation

8.0103, BEACH CHANGES BY EXTRAORDINARY WAVES CAUSED BY HURRICANE CAMILLE

C.J. SONU, Louisiana State Univ. Systems, Coastal Studies Institute, Baton Rouge, Louisiana 70803

Abstract: Drastic erosion and swift recovery were the major characteristics of beach changes associated with Hurricane Camille at Fort Walton, Florida. Storm waves caused general erosion of the beach surface, and a scarp about 1 meter deep was produced about 40 meters behind the shoreline. After the hurricane, humps of sand in a train with regular spacing along the shore emerged in the surf zone bed. These were formed by longshore currents, which probably acted on large quantities of sand brought into the surf zone bed as a result of the preceding subaerial erosion. The humps subsequently moved shoreward and eventually climbed on the beach; a substantial part of the exposed beach volume was thus restored about a week after the hurricane.

Pub. Feb. 70: 19p., NTIS AD-709 428; HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0104, MICROWAVE METEOROLOGY

J.L. KING, U.S. Natl. Aero. & Space Adm., Goddard Space Flight Center, Greenbelt, Maryland 20770 (7470460)

The objective is to develop the microwave radiometer technology for global surveillance of storms from orbit to determine precipitation rate profiles, liquid water content, cloud height, and cloud structure. Passive microwave instrumentation for orbital application will be developed which provide measurements of surface and atmospheric parameters for meteorological requirements. Identification, location, rainfall intensity, wind velocity and storm-systems dynamics information outside the continental United States and especially over the oceans is only minimally available, if at all. Storm surveillance from space can provide these data for most remote and ocean regions. Storm tracking will be of great benefit in: (1) tropical storm characterization for hurricane warning and storm modification and (2) improved maritime meteorology and ship routing to avoid storms. Microwave frequencies (1.0 cm to 10 cm) are most widely used for meteorological probes. They interact strongly with precipitation while undergoing relatively slight attenuation by the gaseous and charged components. Visible and infrared sensors were the first used for earth observation. (Text Abridged)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

8.0105, EXTENDING THE COMPUTERIZED

Abstract: The objective of the research was to develop methods for improved prediction of the movement of tropical cyclones in the 3-7 day time scale; the improved system was to be based on the existing TYPHOON and/or TYPHOON 72 automated programs for producing predictions out to 3 days. The work was divided into 3 tasks: A survey of the 2 existing prediction models and the updating and extending of the analog historical file used by these programs in producing their predictions; to determine the value of large-scale patterns in the prediction of typhoon formation and in subsequent track prediction; to refine the typhoon analog predictive techniques.

Pub. Sep. 73: 105p., NTIS No. AD-770 207/9; PC \$4.25 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0106, BENEFITS OF ENVIRONMENTAL PREDICTION IN THE EASTERN GULF OF MEXICO

M.G. JOHNSON, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Rockville, Maryland 20852

Abstract: Direct and indirect benefits which may be derived from marine environmental prediction are examined in both quantitative and qualitative terms for the eastern Gulf of Mexico area. Conclusions drawn include the following: Of the primary environmental factors affecting the dimensions and types of benefits being derived from marine resources, five appear particularly relevant to commercial fishing and deep-water recreation in the eastern Gulf: Sea state; Air circulation; Temperature; Precipitation patterns; and Special conditions of tropical storms, fog, etc. Sea state is the most significant factor for marine users, followed by wind information. The cost benefits of such predictions are given.

Pub. 1972: 16p., NTIS No. COM-72-11356; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0107, HURRICANE MODIFICATION RESEARCH (PROJECT STORMFURY)

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Rockville, Maryland 20852

Abstract: Project STORMFURY is a collaborative effort to control hurricanes. The approach to be used in the field experiments involves seeding the clouds surrounding the eye of a mature hurricane with silver iodide crystals to release the latent heat of fusion. Approximately 200 canisters of pyrotechnic generators are released at an altitude of about 33,000 feet on a line extending radially outward from the storm center and are distributed over 20 miles. Each generator produces 190 grams of silver iodide. Eligible areas for experimentation which have been authorized by the President's Science Advisor and the Department of State, are the Gulf of Mexico, the Caribbean Sea, and the southwestern North Atlantic region. A tropical cyclone is considered eligible for seeding only if the probability is 10 percent or less that the hurricane center will come within 50 miles of a populated area during the ensuing 18 hours. There is no evidence at this time that any adverse effects have occurred or may be expected to occur as a result of these experiments. There is only a remote possibility that seeding will cause a hurricane to intensify or alter its direction of movement. There is the possibility that under certain circumstances the storm surge will increase even though the maximum winds decrease.

8.0108,

Pub. Jul. 71: 20p., NTIS No. PB-201 257-F; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0108, VISUAL, IR, AND DATA COLLECTION CAPABILITIES OF THE GOES SATELLITE

A.F. FLANDERS, U.S. Dept. of Commerce, Off. of Hydrology, Silver Spring, Maryland 20910

Abstract: The paper concerns a new satellite designated GOES (Geostationary Operational Environmental Satellite) which is scheduled to be launched in 1974 by NASA (National Aeronautics and Space Administration) for NOAA. In synchronous orbit 22,000 miles above the equator, GOES will view the United States from the same point continuously and provide a real time data collection system of particular application to hydrology and the water resources community in general. The two GOES satellite system by virtue of its geosynchronous position possesses (1) a continuous viewing capability of the same area of the earth and (2) a real-time data collection and relay service. This near continuous day and night viewing will provide for the detection and tracking of hurricanes, major storm systems, and severe local storms. The data collection system will make it possible for those in the environmental monitoring and prediction field to obtain much needed observations from remote areas essentially upon demand to better warn of and forecast storm events.

Pub. 1974. 23p., NTIS No. COM-74-10524/8; Reprint.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0109, TROPICAL STORM SURGE FORECASTING

C.P. JELESNIANSKI, U.S. Dept. of Commerce, Techniques Development Lab., Silver Spring, Maryland 20910 (R1610100)

Technical objective: Accelerate modification of the numerical hurricane storm surge forecasting model (SPLASH) to make it suitable for real-time operational use. Determine convenient forms of hurricane input information, as well as easy-to-interpret forms of storm surge forecast output. A feasibility study for real-time storm surge calculations will be made for the U. S. coast of the Gulf of Mexico.

Approach: Work will emphasize the Gulf Coast where land-falling storms generate enormous surges such as observed with Hurricane Camille. A sophisticated computer program will be prepared of such generality that input data of ordinary meteorological parameters will output a storm surge forecast for particular locales. The output will be displayed in convenient form for forecast or planning purposes.

Progress: The hurricane storm surge forecasting program (called SPLASH) in use at NHC was improved with the addition of astronomical tide forecasts and an areal extension to cover any landfalling tropical storms along the coast between Brownsville, Texas and Shinnecock, N.Y. Work then began on modifying the SPLASH program to also cover alongshore-moving tropical storms.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0110, SPECIAL PROGRAM TO LIST AMPLITUDES OF SURGES FROM HURRICANES - I. LANDFALL STORMS

C.P. JELESNIANSKI, U.S. Dept. of Commerce, Techniques Development Lab., Silver Spring, Maryland 20910

coastline. Computations are done by an electronic computer. Surface meteorological parameters are used in the operational program. Qualitative explanations of storm phenomena are interspersed throughout the program. Importance of various meteorological parameters such as shelf topography, and coastal geography are discussed.

Pub. Apr. 72: 58p., NTIS No. COM-72-10810; PC \$0.95.

SUPPORTED BY U.S. Dept. of Commerce

8.0111, SPECIAL PROGRAM TO LIST AMPLITUDES OF SURGES FROM HURRICANES - PART II. TRACK AND VARIANT STORM CONDITIONS

C.P. JELESNIANSKI, U.S. Dept. of Commerce, Techniques Development Lab., Silver Spring, Maryland 20910

Abstract: An operational computer program has been developed to accommodate storms with generalized motions of great complexity. Examples are storms that recurve, remain stationary, accelerate, and decelerate. Also, storm strength and size are allowed to vary in a continuous monotonic manner with time. Since these generalized storms are complicated motions and they can occur on an extensive coastal area (hundreds of miles). Five track positions (spaced at 6-hour intervals along the storm path) and simple meteorological parameters are used as meteorological input for the program. Details of storm phenomena such as explosive deepening, rapid changes in storm track, and sudden changes in storm intensity are not considered. In a qualitative manner, several strange dynamic phenomena associated with the storms with generalized motions are discussed. Special examples are computed by the program and interpreted for forecasting.

Pub. Mar. 74: 62p., NTIS No. COM-74-10921; PC \$1.45.

SUPPORTED BY U.S. Dept. of Commerce

8.0112, JOINT PROBABILITY METHOD FOR FREQUENCY ANALYSIS APPLIED TO SURGES FROM HURRICANES AND LONG BEACH ISLAND, NEW JERSEY

E.A. MYERS, U.S. Dept. of Commerce, National Hurricane Center, Silver Spring, Maryland 20910

Abstract: The paper describes the frequency analysis of combined storm surges and periodic tides prepared for a part of the Long Beach Island study. These surges are added to the ocean beach. Studies of wave action and variations in water levels inshore from the beach are not covered here, nor are other studies such as mapping of the community and damage to structures. The Long Beach Island study is a pilot study in a new area. It is intended to be followed by other studies of other coastal communities to provide needed criteria at this one location.

Pub. Apr. 70: 116p., NTIS No. PB-192 74-1; PC \$0.65.

SUPPORTED BY U.S. Dept. of Commerce

8.0113, MARINE ENVIRONMENTAL PROTECTION - I. MARINE POLLUTION

N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab., Silver Spring, Maryland 20910

Progress. The operational ocean wave forecast program has been modified to generate a teletypewriter bulletin for WSFO San Francisco containing 12-and 36-hour forecasts of swell height, swell period, swell direction, and wind wave height for the North Pacific. The East Coast extratropical storm surge forecast program was extended from 36 up to 48 hours and forecasts were added for Willets Point, N.Y. The operational SPLASH program for forecasting hurricane storm surge has been improved through the incorporation of revised shoaling factors. SPLASH has also been modified to cover alongshore-moving tropical storms. Computerized surface wind forecasts were derived and implemented for Lakes Huron, Michigan, and Superior. Thus, automated wind forecasts are now provided twice daily over teletypewriter for all five of the Great Lakes. The operational Lake Erie storm surge program has been modified to increase its accuracy and extend the forecast period out to 48 hours. Development of wave forecasts for the Great Lakes has been initiated.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0114, SUMMARY OF SELECTED REFERENCE MATERIAL ON THE OCEANOGRAPHIC PHENOMENA OF TIDES, STORM SURGES, WAVES, AND BREAKERS

N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab., Silver Spring, Maryland 20910

Abstract: Contents. Astronomical tide; Extratropical storm surge; Hurricane storm surge; Ocean surface waves; Breakers.

Pub. May 70: 110p., NTIS PB-193-449: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0115, MARINE CONDITIONS AND AUTOMATED FORECASTS FOR THE ATLANTIC COASTAL STORM OF FEBRUARY 18-20, 1972

N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab., Silver Spring, Maryland 20910

Abstract: The storm surge and ocean waves associated with the Atlantic coastal storm of Feb. 18-20, 1972, caused extensive damage along beaches of Long Island and New England. Meteorological conditions of the storm, along with resulting tides, surges, and waves, are described. Comparison is made with forecasts of the storms produced by the primitive-equation model of the National Meteorological Center, as well as with automated forecasts of storm surge and wave height. It is concluded that the meteorological forecasts and the resulting storm surge and wave forecasts were quite good.

Pub. Feb 73: 9p., NTIS COM-73-50496-04-08.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0116, FORECASTING EXTRATROPICAL STORM SURGES FOR THE NORTHEAST COAST OF THE UNITED STATES

N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab., Silver Spring, Maryland 20910

Abstract: The National Weather Service (NWS) has developed a technique for forecasting extratropical storm surges along the northeast coast of the United States. The storm surge is caused mainly by the strong winds associated with extratropical storms over nearshore areas. Empirical forecast equations have been derived for 10 locations from Portland, Maine to Norfolk, Va. with data from 68 storms that occurred from 1956 through 1969. Input data to the technique are sea-level

forecasts from any source. Experience has emphasized the importance of accurate input sea-level pressure forecasts. Indications are that the system is useful. Plans are to include other locations.

Pub. 1974: 74p., NTIS No. COM-74-10719/4: PC \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0117, NAVY ENVIRONMENT - FLUID MECHANICS RESEARCH

G.F. CARRIER, Harvard University, School of Arts and Sciences, Cambridge, Massachusetts 02138 (N00014-67-A-0298-0033)

The Navy has broad programs of research both in turbulent flow phenomena and as to severe storms in their prediction and control. This research should lead to improved understanding: (1) of the initiation, intensification and maintenance of hurricanes thus leading to improved means of influence and control; and (2) of turbulent flow phenomena and the role of polymer additives thus leading to means for optimizing vehicle drag reduction.

The problem of the initiation, intensification and maintenance of hurricanes will be investigated theoretically. An attempt will be made to describe this complex phenomenon in terms of tractable mathematical equations which, although simplified, still retain the essential features of the dynamics. In this manner useful engineering results will be obtained which not only contribute to the understanding of hurricane mechanics but also provide a basis for the development of more complex mathematical models. Experiments of grid turbulence in flowing methanol and studies of shear rate on the viscosity of dilute solutions of polymer additives will be carried out.

Supporting agency address information: Office of Naval Research 438, Arlington, Va. 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0118, PROFILE OF A STORM - WIND, WAVE, AND BEACH EROSION ON THE SOUTHEASTERN SHORE OF MICHIGAN

B.T. FOX, Williams College, Graduate School, Williamstown, Massachusetts 01267

Abstract: A large low pressure system that passed the Michigan during late July 1969, provided opportunity for a detailed analysis of storm effects on beach and coastal processes. During the passage of this storm, observations of 17 environmental parameters were being recorded at 17 intervals. These data were subjected to Fourier analysis and plotted in a time series by computer. Such analysis indicates that there is a definite relationship between barometric pressure, breaker height, breaker angle and longshore current velocity. These are among the significant factors in beach erosion. As the storm passed, the beach and dune underwent extensive erosion. The post-storm profile of a nearshore sand bar which was derived from the bathymetry during the storm. During succeeding days, this bar underwent shoreward migration and was eventually incorporated into the beach.

Pub. 1970: 9p., NTIS No. AD-723 932: Reprint.

SUPPORTED BY U.S. Dept. of Defense - Navy

Purpose of study/investigation: To determine the effects of a hurricane protection structure with all tidal passages open on tidal heights, current velocities, salinities, temperatures, and dye dispersion within Jamaica Bay for normal tides. Plans which had no adverse effects on the above phenomena and which did not create maximum velocities hazardous to navigation were subjected to hurricane surges to determine the amount of suppression obtained throughout Jamaica Bay. An additional objective of the investigation to improve the quality of water in the Bay has been added by the New York District. This modification may involve barrier gate operation and/or structural changes in the Bay.

Approach or plan: The Jamaica Bay segment of the existing New York Harbor Model was updated to topographic conditions of 1967. The existing New York Harbor model linear scale ratios are 1:100 vertically and 1:1000 horizontally. A hurricane surge generator was added to the model to conduct the surge test. A series of tests was conducted for existing conditions and then duplicated for plan conditions; comparison of test results allows the effects of the plans to be evaluated.

Progress to date: New York District personnel recommended a barrier plan consisting of a 300-ft-wide ungated navigation opening to natural bottom depths (approximately -32 ft msl) plus six 75-ft-wide gated tidal passages with bottom sills to an elevation of -26 ft msl on each side of the navigation opening. Model tests indicated no adverse effects on tidal heights, current velocities, salinities, and dye dispersion within Jamaica Bay; however, the plan would not provide adequate suppression of the hurricane surge elevations within the Bay. Plan 6 included a 110-ft wide ungated navigation opening to natural bottom conditions plus eight 75-ft-wide gated tidal passages with bottom sills to elevations of -26 ft msl on each side of the navigation opening. This plan had no adverse effects on the related phenomena and provided the required suppression of hurricane surges within the Bay; however, the 110-ft-wide navigation opening did not meet the present navigation needs which require a minimum opening of 150 ft. A series of hurricane surge tests was conducted utilizing widths of navigation openings varying from 150 to 200 ft. These openings provided bottom sill elevations varying from -23 ft msl to -26 ft msl.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0120, MICRO AND MESOSCALE GEOPHYSICAL FLUID DYNAMICS

Y. KURIHARA, Princeton University, Graduate School, Princeton, New Jersey 08540

The objectives of this research involve study of four geophysical phenomena of relatively small scale using numerical modelling techniques. The investigations include: construction of a three-dimensional model to study the asymmetric structure of hurricanes as it affects genesis and movement of the system; the use of a three-dimensional model of convective motions to study the effect of vertical wind shear of cloud band orientation; the application of ocean circulation models to motions in a lake; and modelling the effects of confined heating on the atmospheric boundary layer and the free atmosphere through the agency of internal gravity waves.

SUPPORTED BY U.S. Natl. Science Foundation

8.0121, CASE STUDIES OF COASTAL CONVECTIVE

Abstract: The life cycles of coastal convective storms are studied utilizing a Doppler weather radar. The storms involve storms triggered by the sea breeze and vertical scanning as well as fixed vertical scanning utilized to observe the storms. Analyses suggest that convective storms move with the wind updraft rather than the environmental wind. Interaction between the vertically moving air and the horizontal flow determines the time history of the storm.

Pub. Apr. 74: 75p., NTIS No. AD-778 361-51.45.

SUPPORTED BY U.S. Dept. of Defense -

8.0122, ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES (FOR SELECTED STATIONS) (MONTH OF SEPTEMBER)

H.L. CRUTCHER, U.S. Dept. of Commerce, Center, Asheville, North Carolina 28801

Tropical cyclone strike probabilities for selected stations for the several specified seasons and time intervals. The selected stations are Cape Kennedy, Florida; Test Facility, Bay St. Louis, Mississippi, Virginia; and Houston, Texas. The seasons are August, September, October, and November. The time intervals are 12-, 24-, 36-, 48-, 72- and 96-hour periods. September strike probabilities are shown for the time periods for the five-degree latitude-belt in the North Atlantic, Caribbean and Gulf of Mexico. Strike probabilities are given for circles having two and three degrees of latitudes and centers at the selected station or the centers of the five-degree latitude squares. These probabilities are compared with statistical climatologies of tropical cyclone strikes presented by Crutcher (1971). The model assumes a bivariate normal distribution.

Pub. Aug. 71: 104p., NTIS No. N71-35765:

SUPPORTED BY U.S. Natl. Aero. & Space

8.0123, PRELIMINARY CLIMATIC DATA FOR HURRICANE AGNES JUNE 14-23, 1972

R.M. DEANGELIS, U.S. Dept. of Commerce, Center, Asheville, North Carolina 28801

Abstract: The report gives a preliminary climatic data for Hurricane Agnes June 14-23, 1972, and its sequences. Hurricane Agnes caused one of the most disastrous in United States history. Records showed that Agnes caused floods from North Carolina to New York, Pennsylvania, New York, Virginia, and Florida was beset with storm tides and tornados. Given concerning the storm history, the climatic records from ship land and aircraft records and from remotely sensed observations (satellite). Data are given on extremes of pressure, wind, and rainfall. New records were established. Appended are the chronology of the hurricane, maps of the storm, weather maps, and preliminary flood stages.

Pub. Aug. 72: 67p., NTIS No. COM-72-111-50.95.

SUPPORTED BY U.S. Dept. of Commerce

8.0124, ALTERNATIVE ADJUSTMENT

Federal flood control policy which is leading to changes in Federal policy. Response to the drought of the mid-1960's in Massachusetts is analyzed. Arguments are presented against single solutions, and emphasis is placed on the need for research on alternatives.

Pub. Dec. 71: 127p., NTIS No. PB-211 922; PC \$5.45 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0125, NUMERICAL STUDIES OF RAINBAND CIRCULATIONS IN TROPICAL CYCLONES

R.A. ANTHES, Penn. State University, School of Earth Sciences, University Park, Pennsylvania 16802

The general objective of this research is to model numerically the rainband circulation of tropical cyclones. The specific areas to be investigated are as follows. (1) the generation mechanisms - a study of what physical processes in the model are necessary and sufficient for the rainband scale instability. Linear techniques will be used as well as integration as an initial value problem of the time-dependent, linearized equation. (2) The possibility of a CISK-type process operating on the scale of the bands - careful study of the low-level vorticity and divergence patterns should help to ascertain the importance of the parameterized convective heating on the maintenance of the rainbands. (3) The contribution of the bands to the energy and angular momentum budgets of the tropical cyclone - budget calculations should determine the relative importance of these processes. (4) The possible effects on storm dynamics of enhancement or suppression of the bands - once an understanding of the interactions between the rainbands and the tropical cyclone circulation are understood, it may be possible to simulate numerically modification of the rainbands.

SUPPORTED BY U.S. Natl. Science Foundation

8.0126, ANALYTICAL PHYSICAL MODEL

F.M. WHITE, Univ. of Rhode Island, School of Engineering, Kingston, Rhode Island 02881

Objectives: The objective of this project is to develop and verify a mathematical computer model which has the capability of predicting the spatial and temporal variations of the physical characteristics of Narragansett Bay. When completed, this model should be able to compute, at any time in the past or future and at any point in the Bay, the tidal heights, current salinity, temperature, and certain chemical species concentrations, notably dissolved oxygen. The model will also be able to take account of proposed changes in the dynamics of the Bay, such as hurricane barriers, thermal discharges, sewage outfalls, and channel dredging, with a view toward its use in decision-making and management of Narragansett Bay. The experimental verification of the model is being provided by the Bay Watch program.

How information will be applied: the information derived from this model has three primary uses: 1) to aid in Bay management by providing design studies of proposed physical changes; 2) to provide detailed predictions of the physical state of the Bay, in the past or in the future, for use in coordinating experimentation in the Bay; and 3) to provide physical parameters for use with the associated biological and socio-economic models being prepared under other projects associated with the Systems Model Studies.

flow rates at various key points in the Bay. 2. The depth-averaged salinity model is now being applied to dye study problems. 3. The temperature model is now being applied to the proposed Rome Point power plant. 4. The laterally-averaged, water-quality model has been completed and successfully compared to dissolved oxygen and biochemical oxygen demand data from the Bay. 5. A finite-element model for rapid calculations of physical and biological parameters in the Bay is now being developed, in cooperation with the Systems Ecology Project.

For additional information pertaining to this project contact Dr. Niels Rorholm, Coordinator, Sea Grant Programs, University of Rhode Island, Kingston, Rhode Island 02881.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0127, SOUTH CAROLINA HURRICANES OR A DESCRIPTIVE LISTING OF TROPICAL CYCLONES THAT HAVE AFFECTED SOUTH CAROLINA

J.C. PURVIS, U.S. Dept. of Commerce, Natl. Weather Service, Columbia, South Carolina

Abstract: The publication contains a descriptive listing of tropical cyclones that have affected South Carolina and for which records are available. The record begins with two storms in the 17th century and continues to date. Introductory notes on hurricane phenomena and September gales are followed by a statement on modern tracking and warning. Finally there is a chart showing the number of tropical cyclones by month, percent of seasonal total and the number of cyclones per year, for various time periods.

Pub. 1973: 56p., NFIS No. COM-73-11533/9; PC \$5.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0128, INVESTIGATION OF SHORELINE CHANGES AT SARGENT BEACH, TEXAS

R.N. SEELEIG, Texas A & M University System, Graduate School, College Station, Texas 77843

Abstract: An environmental study was conducted at Sargent Beach, Texas, an erosive beach bordering the Gulf of Mexico. The objectives of this study were to determine the characteristics of the beach, the magnitudes of changes which have occurred at Sargent Beach, and to analyze possible factors which may be controlling the observed beach changes. Results show the beach has eroded at an increasing rate since at least 1930 with recent shoreline retreat rates averaging 30 feet per year. Storms are the primary agents that remove material from the beach, while lost sediments are not replaced because Brazos River sands normally expected to move alongshore are trapped in the Brazos delta. Hurricanes may free stored deltaic sands carrying major quantities offshore from beach areas. Beach erosion is further aggravated by decreased sand input to the coast from the Brazos River due to alterations to the river and its drainage basin in the 1940's.

Pub. Sep. 73: 162p., NTIS No. COM-74-10157/1; PC \$4.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

8.0129, OBJECTIVE ANALYSIS OF THE SEA SURFACE TEMPERATURE

B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Weather Service, Fort Worth, Texas 76102

Abstract: A program has been developed which analyzes sea surface temperatures on an operational and research basis. Data were composited for five-day periods from the thirteenth to the seventeenth for the months of June, August, September, and October, during the 1972 hurricane season. Sea surface temperature and anomaly charts were computed. These charts are discussed in relation to tropical cyclone activity. A relationship exists between tropical cyclone activity and sea surface temperature. The real-time, objective analysis of sea surface temperature and computation of anomalies identify those areas of warm SST which can serve as ready sources of energy for development or intensification of tropical cyclones.

Pub. Aug. 73: 21p., NTIS No. COM-73-11643/b. PC \$2.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

8.0130, A DECISION PROCEDURE FOR APPLICATION IN PREDICTING THE LANDFALL OF HURRICANES

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service, Fort Worth, Texas 76102

Abstract: A Bayesian analysis, in real time, is made on the performance of competing numerical and statistical models in predicting the point at which a hurricane will make its landfall on a virtual coastline, 18 and 30 hours following the observations upon which the forecast is based. The results indicate to the hurricane forecaster how each model has performed and will identify the model whose next prediction will have the most dependable basis for a warning decision. This example of a machine program to process and organize information on the performance of competing hurricane prediction methods illustrates how Bayesian analyses may be combined with other statistical parameters to supply a basis for sound decisions on critical forecast problems. It is expected that this initial effort will open up many new avenues for applying decision and information analyses to the more formidable and intractable weather prediction problems, especially those of the tropics.

Pub. Aug. 73: 16p., NTIS No. COM-73-11663/4. PC \$2.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - NOAA.

8.0131, THE DECISION PROCESS IN HURRICANE FORECASTING

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service, Fort Worth, Texas 76102

Abstract: The main thrust of development programs at the National Hurricane Center is to provide objective diagnostic methods for evaluating the numerical prediction results by analyzing the dynamical character and tendencies of the vortex environment and of the vortex itself. The procedures and decision ladders for each phase of the forecast are described, including the positioning of the center, the development of a disturbance, growth of a vortex, and movement of the center.

Pub. Jun. 71: 39p., NTIS No. COM-71-00336. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - NOAA.

8.0132, ATLANTIC HURRICANE FREQUENCIES ALONG THE U.S. COASTLINE

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service, Fort Worth, Texas 76102

Abstract: From a recently completed climatology of hurricanes at the National Hurricane Center covering a period of 85 years of record, the total number of incidents and the

Pub. Jun. 71: 19p., NTIS No. COM-71-00750.95.

SUPPORTED BY U.S. Dept. of Commerce

8.0133, SEDIMENT MOVEMENT AND MORPHOLOGY IN THE CENTRAL APPALACHIANS - VIRGINIA

UNKNOWN, U.S. Dept. of the Interior, Arlington, Virginia 22209

Sediment, particularly in connection with mud floods, causes many deaths and millions of dollars of damage annually. The destruction results from its movement down hillsides and along its deposition. The prediction of impeding events and the prevention or reduction of its deposition cannot be possible until systematic, planned geomorphic studies are made.

To derive a basis for predicting the occurrence of major sediment movements on hillslopes in the Central Appalachians and nearby areas, to prevent or reduce the customary widespread damage to man and his property from such movements.

Document and examine the geomorphic features of catastrophic sediment movement which resulted in central Virginia from the Canfield in 1969. Measure and evaluate the rate of erosion, the amount and location of sediment particles involved, geomorphic features of affected and unaffected hillslopes and valleys, and features which may aid in attaining the results.

Obtain further field data on channel morphology and material samples. Continue analyzing channel geometry. Write further portions of first report on same. Results to date show some promising relationship between flow characteristics and certain measurable features of the channel cross-section and sizes of bed material.

Complete the analysis of the data on channel morphology as the need arises; draw conclusions and draft of manuscript.

SUPPORTED BY U.S. Dept. of Interior

8.0134, FORECASTING STORM-INDUCED CHANGES ALONG VIRGINIA'S COAST

W. HARRISON, Virginia Inst. of Marine Sciences, Virginia 23062

Abstract: The purpose of this study was to develop a method for operational prediction of storm-induced changes. The thought was to use wind and wave data that are predicted on a routine basis by the National Weather Service, NOAA, and it was felt that if such a method could be developed, it would be possible to forecast beach erosion or deposition as part of the storm forecasts whenever storms threatened. It might be possible to make estimates of the changes during previous years by using historical data in the prediction scheme.

Pub. Dec. 71: 117p., NTIS No. AD-75250.95.

SUPPORTED BY U.S. Dept. of Defense

8.0135, OPERATION AGNES

A. KUO, Virginia Inst. of Marine Sci., Gloucester Point, Virginia 23062

System and on the transport of material substances including nutrients, suspended sediments, pesticides and metals. Other phases of the study are focusing on the impact of biologic components. Our emphasis is on the path of Susquehanna River water as it passes down the Bay, out of the mouth and onto the shelf. This phase of the work interfaces within the total program with the ongoing monitoring programs in the James, York and Rappahannock Rivers.

SUPPORTED BY U.S. Natl. Science Foundation

8.0136, STORM-SURGE FORECASTING

J.W. NICKERSON, U.S. Navy, Weather Research Facility, Norfolk, Virginia 23511

Abstract: The report contains an adaptation of a unique storm-surge forecasting technique developed by Dr. C. P. Jelesnianski. This technique results in a computed storm surge profile at the inner boundary of an artificial standard basin seaward of the coast. The profile is derived from nomograms based upon a standard storm passing over a standard basin. Thumb rules and guidelines are presented in the publication for subjectively modifying the computer storm surge height as it moves shoreward of the artificial basin boundary, to fit the natural conditions of a particular coastline. Major advantages of this system are its applicability to almost any locale, its adaptability to data normally available to the field forecaster and the speed with which the forecast may be modified to remain current with natural fluctuations of the storm.

Pub. Apr. 71: 100p., NTIS No. AD-751 578; PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0137, ENERGY, MASS AND ANGULAR MOMENTUM BUDGETS OF EXTRATROPICAL CYCLONES

D.R. JOHNSON, Univ. of Wisconsin, Graduate School, Madison, Wisconsin

The objective of this research is to study the energy, mass, and angular momentum budgets of the extratropical cyclone. Particular emphasis will be placed on the roles of the polar jet stream and diabatic processes during the life of cyclones. Several case studies of developing and dissipating stages are proposed to compare the relative importance of angular momentum and energy fluxes across the lateral boundary of the storm volume with the vertical redistribution and sources and sinks within the volume. Through these comparisons the interaction of the extratropical cyclone with its environment will be examined. In support of the examination efforts will also be made to develop objective analysis techniques which can be applied to studies of the extratropical cyclone and jet stream.

SUPPORTED BY U.S. Natl. Science Foundation

8.0138, NUMERICAL STUDIES IN THE CIRCULATIONS AND STORM SURGES IN LAKE ONTARIO

D.B. RAO, Univ. of Wisconsin, School of Letters, Milwaukee, Wisconsin 53201

This study will carry out integrations on a sequence of numerical models to determine (1) the three-dimensional circulation patterns induced by seasonal winds, (2) the changes in the mean circulation patterns in response to changes in seasonal winds, and (3) the lake level response induced by severe atmospheric disturbances. The shape of the coastal boundary and bottom topography will be taken into account in the nu-

9. LAND SLIDES

DISASTER MITIGATION

9.0001, REGIONAL GEOLOGIC FRAMEWORK - SAN ANDREAS FAULT - CALIFORNIA

T.W. DIBBLEE, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The objective of this project is to produce a geologic map of a belt some 80 km wide along a 500-km-long segment of the San Andreas fault zone from Hollister to Desert Hot Springs. The geology is being plotted on available 15' 1:62,500-scale and 7 1/2' 1:24,000-scale topographic quadrangles base maps from field work and from adequate published and available unpublished geologic mapping. All these data are being compiled onto four specially prepared 1:125,000-scale topographic base maps, each covering a 125-km long segment of the San Andreas fault. Each of these geologic maps will be accompanied by several cross sections and descriptions of the rock units. Also planned for publication are several 1:62,500-scale quadrangle transects astride certain critical parts of the fault.

The basic geology mapped throughout this area will serve many purposes, such as location of materials suitable for construction of highways, canals, and dams; location of geologic hazards such as faults, landslides, and unstable rock units; and classification of land and exploration for water, petroleum or gas and mineral deposits.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0002, REGIONAL SLOPE STABILITY STUDIES - CALIFORNIA AND PENNSYLVANIA

D.H. RADBRUCHHALL, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

Topic: study to determine regional geologic factors that contribute to land-sliding in selected areas of the United States. Areas are being studied in Northern Coast Ranges and the Transverse Ranges of California, and in the vicinity of Pittsburgh, Pennsylvania. Principal objectives are to determine which regional geologic factors (as opposed to local factors triggering individual slides) or combination of factors are critical in determining regional slope stability, so that these factors can be taken into account in planning and construction, particularly of large projects. The work will consist of literature search covering all pertinent data on such factors as climate, slope, tectonic and geologic history, and erosion rates; aerial photograph studies to map distribution of landslides in study areas; examination of selected landslides on the ground to determine their characteristics; and field examination of geologic units in study areas to determine their pertinent physical properties, including composition, weathering, permeability, and state of fracturing. The study may involve measurements of state of stress in the earth's crust and its relationship to regional landslide patterns.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0003, MOBILIZATION OF DEBRIS FLOWS 9973-EN

A.M. JOHNSON, Stanford University, School of Earth Sciences, Palo Alto, California 94305 (DA-ARO(D) 31-124-71-G158)

To study debris-flow, a form of rock waste transport. This work is concerned with the fundamentals involved in the cause and effect of debris-flow, such as conditions, such as topography,

Field investigations, laboratory experiments and theoretical studies of this selected type of landslide will be studied.

Supporting agency address information: OCRD Research Office
Durham, Durham, N.C. 27706

SUPPORTED BY U.S. Dept. of Defense - Army

9.0004, GENERAL REVIEW OF THE SEISMIC HAZARD TO SELECTED U.S. NAVY INSTALLATIONS

J.B. SEED, Calif. Inst. of Technology, Graduate School,
Pasadena, California 91109

Abstract: The report summarizes the findings of the Natural Hazards Review Panel whose mission it was to investigate the nature and magnitude of the threats posed to Naval bases by earthquakes and earthquake-related natural hazards including tsunamis, seiches (and the accompanying flooding), landslides, mudflows and soil foundation failures which may result from earthquakes. In addition to citing specific problems for Naval bases in the San Francisco, San Diego and the Manila areas, the introduction to this report recommends conducting a rapid visual survey initially to pinpoint the nature of various danger areas. It then recommends the follow-on procedure leading to various strategic and engineering decisions which will provide the required degree of protection to insure Fleet Operational Readiness and to provide cost effectiveness in protecting the Navy against serious earthquake damage.

Pub. Jan. 74, 45p., NTIS No. AD-778 005/9: PC \$3.25 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Navy

9.0005, EARTHWORK REINFORCEMENT TECHNIQUES - LOS ANGELES AREA

R.A. FORSYTH, State Div. of Highways, Sacramento, California
95814

A 'reinforced earth' test installation will be constructed as part of a landslide correction project on Rte 39 near Los Angeles for the purposes of evaluation of construction cost and behavior. The test embankment will be instrumented with strain gages, slope indicators, soil pressure cells and extensometers. Resulting data will be utilized to evaluate current 'reinforced earth' design procedures and theories.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

9.0006, SUBAUDIBLE ROCK NOISE (SARN) AS A MEASURE OF SLOPE STABILITY, CALIFORNIA

R. MEARNS, State Div. of Highways, Sacramento, California
95814

Abstract: A technique for using subaudible rock noise (SARN) to measure slope stability has been developed by the California Division of Highways. The technique and the equipment used are described and instructions for their application are presented. Several case histories are described to illustrate some of the types of problems to which SARN monitoring can be applied. The Division is planning to perform SARN monitoring as a routine method for stability evaluation and is assembling the necessary equipment.

Pub. Aug. 73: 62p., NTIS No. PB-227 965/1: PC \$3.75 MF \$1.45.

SUPPORTED BY California State Government - Sacramento

9.0007, URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR STATE

Abstract: This report recommends loss-reducing solutions to 10 geologic problems which collectively estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake hazards, mineral resources to urbanization, land use planning, erosion activity, expansive soils, fault displacement, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effective reduction measures, and agencies responsible for their solution.

Pub. Jun. 73: 111p., NTIS No. PB-227 965/1: PC \$1.45.

SUPPORTED BY U.S. Dept. of Housing and Urban Development

9.0008, RIPRAP SLOPE PROTECTION DAMS - A REVIEW OF PRACTICES AND PROCEDURES

F.J. DAVIS, U.S. Dept. of the Interior, Bureau of Reclamation,
Denver, Colorado 80225

Abstract: Bureau of Reclamation practices for riprap slope investigation, sampling, testing, and field application. Riprap slope protection for earth dams are reviewed. 50 case histories of riprap slope protection are presented. Performance of most upstream slope protection with riprap dams has been essentially as anticipated. The most important factor in providing upstream slope protection, in addition to proper design, is lifetime maintenance costs, is the proper selection, designing, and constructing the protection. Although experience indicates that a riprap blanket larger than 1 cu yd would be required on most dam structures to protect slopes against storms, few rock sources can provide this quantity. Hence, a 36-inch blanket of riprap granules is considered the maximum protection that can be obtained. Specifications should be revised to require gradation that contains more of the larger size material, placing requirements to obtain a denser riprap, and greater selectivity of quarry material, and use of quarry blasting techniques. Detailed case histories of riprap sources are included.

Pub. Mar. 73: 28p., NTIS No. PB-219 805/1: PC \$0.95.

SUPPORTED BY U.S. Dept. of Interior

9.0009, LOCATION OF SLOPE FAILURE - A REVIEW OF PRACTICES AND PROCEDURES

R.H. MERRILL, U.S. Dept. of the Interior, Bureau of Reclamation,
Denver, Colorado 80225

The object of this research is to detect failure of slopes before slope sliding occurs. Success in this work will result in a knowledge of the location of failure zones and will give early information from which action can be taken to avoid disastrous slides in slopes. The planes will be monitored for microseismic activity. Noises shall be used in an attempt to triangulate the location of the noise. The work will be performed by the Bureau of Reclamation, Ruth mine, Kennecott Copper Corporation.

SUPPORTED BY U.S. Dept. of Interior

9.0010, SHEAR STRENGTH OF FINE GRAINED SOILS - WEST POINT, NEW YORK

UNKNOWN, Transportation Res. Board,

Performance of a fill foundation at West Point, New York; A method for determining the strength parameters of soils; Characteristics of some clay soils from Wisconsin.

Pub. 1973: 71p., NTIS No. PB-227 031/2: PC \$2.20 MF \$1.45.
SUPPORTED BY Natl Academy of Sciences - Washington

9.0011, ENGINEERING GEOLOGY - ILLINOIS

W.C. SMITH, State Geol. Survey, Urbana, Illinois 61801

Geological conditions and their relationship to engineering problems are being researched. Cooperation is extended to other state departments with special reference to highway construction, dam sites, reservoirs, foundation conditions. Field conferences, examination of borings, and preparation of reports are undertaken for other state departments or at the request of consulting engineers engaged on various projects. Reports issued: 'Geologic Factors in Dam and Reservoir Planning', W.C. Smith, Ill. St. Geo. Surv. Environmental Geol. Note 13, 1966. 'Geology and Engineering Characteristics of Some Surface Materials in McHenry County, Illinois', W.C. Smith, Ill. St. Geo. Surv. Environmental Geol. Note 19, 1968. 'Preliminary Geological Evaluation of Dam and Reservoir Sites in McHenry County, Illinois', W.C. Smith, Ill. St. Geo. Surv. Environmental Geol. Note 25, 33pp, 1969. 'Geologic Investigation of the Site for an Environmental Pollution Study', P.B. Dumontelle, Illinois State Geological Survey Environmental Geology Note 31, 1970. 'Landslides Along the Illinois River Valley South and West of La Salle and Peru, Illinois', P.B. Dumontelle, N.C. Hester, and R.E. Cole, Illinois State Geological Survey Environmental Geology Note 48, 1971.

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SUPPORTED BY Illinois State Government - Springfield

9.0012, STRESS-STRAIN-TIME BEHAVIOR OF SOIL AND ROCK UNDER TRIAXIAL CONDITIONS

G. MESRI, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

This study deals with the creep properties of soil and rock under triaxial conditions. An elaborate constant-load triaxial testing system has been designed and constructed. The creep testing system (CTS) consists of four independent units. The axial loads, axial deformations, cell pressures, and pore pressures are automatically observed and recorded by a digital indicator and teletype. Tests are being performed on soil and soft rock specimens using various load and time histories. Presently available creep equations (stress-strain-time relations) for soil and rock are being analyzed. An attempt is being made to extend our understanding of the physical significance of creep parameters. Also new creep equations are being developed.

SUPPORTED BY University of Illinois

9.0013, WATER DRAINAGE FROM IN-PLACE FILLS TO PREVENT OR HALT FILL

P.C. CLARK, State Highway Commission, Topeka, Kansas 66612 (2R63226543)

Objectives are to determine the conditions that lead to fill slides on highways and to develop means of preventing or halting such slides. Hydrologic and man-made geologic conditions existing in each fill, under study, are being determined. Vertical drains are being installed in some fills to see if draining of water will help stabilize the fill and halt or prevent fill slides. Water flow measurements are being made

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SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

9.0014, INVESTIGATION OF LANDSLIDES ON HIGHWAYS

J.H. HAVENS, State Div. of Res., Frankfort, Kentucky (2R63201259)

Study is conducted to evaluate and improve current exploration methods and techniques of interpretation of subsurface conditions and available methods for analysis, design and construction whereby embankment failures on highway facilities can be minimized.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

9.0015, LANDSLIDES - KENTUCKY

C.T. GORMAN, State Bur. of Highways, Lexington, Kentucky 40508

Side-hill cut-and-fill sections are typical design features of roadways in much of the mountainous or hilly terrain of Kentucky. Lateral seepage of groundwaters into side-hill fills and attendant damming and increased pore pressures have been suspected as major causes of landslides. Monitoring and surveillance of potential landslides will be conducted for collection of data for use as future design remedies. Study objectives are to 1) determine the causes of side-hill instability, 2) observe long-term movement using slope indicators at selected sites where side-hill failures are in progress, 3) develop an automated direct shear apparatus for measuring peak and residual soil shear strength, 4) develop correlations between laboratory triaxial shear strength and in situ shear strength obtained from ditch cone penetration tests and vane shear tests, and 5) compare peak, residual, and in-situ strength with calculated shear strength at sites where failures are occurring.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY Kentucky State Government - Frankfort

9.0016, SLOPE STABILITY OF CUTS IN ONTONAGON CLAY

I.A. ALNOURI, State Dept. of Highways, Lansing, Michigan (2R63221066)

The main objectives are (1) Record and analyze existing slides. Determine actual shearing strength of soil and causes of failure. (2) Suggest suitable and economical corrections for existing slides. Recommend preventive measures for potential slide areas. (3) Propose a procedure for slope stability analysis to be used in the future design of cuts in on-tonagon clay.

Document provided to S.S.I.E. By the H.R.I.S.

SUPPORTED BY Michigan State Government - Lansing

9.0017, CLAY MOBILITY IN RIDGE ROUTE LANDSLIDES, GORMAN, CALIFORNIA

P.F. KERR, Columbia University, School of Arts, New York, New York 10027

Abstract: Several landslides with substantial displacements along clay-bearing bedding planes occur in road cuts along the Los Angeles - San Francisco super highway Interstate 5, between Castaic and Gorman. Geometrically such slides occur where the strike of wet clay-bearing strata in road cuts lies parallel to the roadway, and the inclination is toward the roadway at an angle less than the slope of the cut. They are

9.0018.

Pub. Jul 70: 49p., NTIS No. AD-715 920: PC \$3.00 MF \$0.95.
SUPPORTED BY U.S. Dept. of Defense - Air Force

**9.0018. INVESTIGATION OF RED RIVER VALLEY
GEOLGY - EFFECTS ON STRUCTURE DESIGN AND
PERFORMANCE**

D.K. LEER, State Highway Department, Fargo, North Dakota
58102

Abstract: The investigation includes a detailed study of the geology, past performance of structures, and soil mechanics. The sites selected for the study of the soils and landslides were instrumented with slope inclinometer to establish shear planes and to evaluate the strength of the soils in the field as compared to laboratory strength analysis. Through this procedure, the residual soil strengths can be used for design purposes and the reactions imposed on structures can be estimated. The investigation indicated that the main factors contributing to the river bank failures are the loads imposed by embankments and by draw-down after periods of flooding. Recommendations for new bridge design are given.

Pub. Sep 70: 59p., NTIS No. PB-196 133: PC \$3.00 MF \$0.95
SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

**9.0019. SLOPE STABILITY OF CERTAIN SELECTED
COLLUVIAL SOILS**

C.J. HAYES, State Dept. of Highways, Oklahoma City,
Oklahoma (2R63221056)

The degree of stability of colluvial soils will be rated and classified according to the degree of hazard so that the stability problems, e.g. landslides, can be anticipated. Mapped unstable soils (colluvium) are selected and a moisture sensing apparatus is placed in the soils to monitor the types and amount of flow. Underdrains of various types are placed in the colluvium at selected locations with changes in the flow of moisture to be monitored. Slope stability ratings of certain mapped soils will be made available to design engineers so that unstable slope conditions can be rectified or avoided.

Document provided to S.S.I.E. By the Highway Research Information Service

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

**9.0020. FLOW SLIDE CONTROL WITH SLOPE REVET-
MENTS**

W.L. SCHROEDER, Oregon State University, School of Engineering, Corvallis, Oregon 97331

The proposed research is aimed at developing design criteria for revetment-type protection of loose submerged cohesionless soil slopes. The proposed research program involves scaled laboratory experiments to determine relationships among several variables (liquefaction, densification, pore pressure, etc.) and slopes subjected to vibrational or shock induced loading.

SUPPORTED BY U.S. Natl. Science Foundation

**9.0021. ROCK STRENGTH FROM FAILURE CASES -
POWERHOUSE SLOPE STABILITY STUDY, FORT PECK
DAM, MONTANA**

J.V. HAMEL, Hamel Geotechnical Consultants, Rapid City,
South Dakota 57701

MAJOR

Upper Missouri River Valley. The Fort Peck site geology are briefly described. Stability of the powerhouse slope are presented and recommendations are given for further study in connection with detailed planning of stabilization.

Pub. May 73: 183p., NTIS No. AD-761 500: PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense

**9.0022. LANDSLIDE STUDIES IN SOUTH DAKOTA -
PORT NO. 1 - LOCATION OF AREAS OF HIGH
SLIDE POTENTIAL IN THE PIERRE SHALES**

J. SCULLY, State Geol. Survey, Pierre, South Dakota 57506

Abstract: Areas with a high landslide potential are areas where the shale has a high degree of saturation. Landslides occur in certain geologic members of the Pierre. Several methods for locating areas with high landslide potential. Areas with a high landslide potential have higher seismic velocities, lower penetration resistance values in areas with high landslide potential will be lower than the values in stable areas. Results of strength tests run on samples from high slide potential differ from those of stable slopes. The water contents and the degree of saturation are higher and the unconfined compressive strength and modulus of deformation is lower. The results of samples in potential slide areas often fail at lower stresses and the peak strength occurs at higher strains. Methods for locating areas with high landslide potential are avoided, or stabilized during highway construction.

Pub. Dec 70: 84p., NTIS No. PB-201 155: PC \$0.95.

SUPPORTED BY U.S. Dept. of Transportation

**9.0023. A SURVEY OF EARTH SLOPE FAILURE
REMEDIAL MEASURES IN TEXAS**

T.G. ABRAMS, Univ. of Texas, Ctr. for Earthquake Engineering, Austin, Texas 78712

Abstract: The results of a survey undertaken in Texas where there has been a high incidence of failure and to identify some of the factors involved in these slides are presented. In conjunction with a review of present slope design procedures, remedial measures employed by the Texas Highways Dept. for repair and maintenance of earth slopes are reported. The major slope failures of significance are associated with primarily excavated fissured clays and clay shales, although some failures of fill slopes constructed of high strength materials also encountered in several areas. Remedial measures have been employed for repair of failures including regrading, stabilization with lime, cement, and various forms of restraint or anchoring. While excessive amounts of ground water are usually present at most sites where slope failures occur, drainage of water has not been considered as a remedial or preventative measure.

D.N. SWANSTON, U.S. Dept. of Agriculture, Pac. N.W. For. & Rg. Exp. Sta., Juneau, Alaska 99801

Abstract: Studies indicate a combination of total saturation, slopes with gradients above the natural angle of stability (greater than 34 degrees), and loss of the stabilizing effect of anchoring tree roots are the principal causes of debris avalanching on till soils in southeast Alaska

Pub. Sept. 70: 21p., NTIS No. PB-194 166: MF \$0.65.

SUPPORTED BY U.S. Dept. of Agriculture

9.0025, COLLABORATIVE RESEARCH ON SOIL-CEMENT SLOPE PROTECTION FOR EARTH EMBANKMENTS

J.K. MITCHELL, Univ. of California, School of Engineering, Berkeley, California 94720

This is a joint effort between the Universities of California at Berkeley and at Davis in which the objectives are to: 1. Evaluate the performance of existing soil-cement slope protection for earth embankments. 2. Characterize the erodibility and weathering of soil-cement mixtures under controlled laboratory conditions. 3. Critically review the suitability of the 'borrowed' durability test criteria for soil-cement when used for slope protection design. 4. Predict the field performance of soil-cement slope protection by conducting simulated model tests. 5. Suggest new design criteria for soil-cement slope protection for earth embankments, if appropriate.

The soil-cement laboratory and model studies will be carried out on the Davis campus, and the investigation of other chemical additives as soil stabilizers for slope protection shall be conducted on the Berkeley campus.

SUPPORTED BY U.S. Natl. Science Foundation

9.0026, ENGINEERING GEOLOGIC REPORT OF GENERAL PLAN STUDY FOR THE CITY OF GLEN DORA, CALIFORNIA

F.B. LEIGHTON, Glendora City Government, Glendora, California

Abstract: Contents: General geology; (Geologic setting, Geologic earth units); Geologic features and processes influential in planning; (Dip slopes, landslides, rockfalls and soil failures, faults, seismic activity, expansive units, perched ground water, flooding, erosion and deposition, avoiding flood and mudflow hazards); Resource materials; (Sand, gravel and riprap, water resources, subbase and base materials); Geologic guideline to hillside development; Suggestions for a model building and grading code.

Pub. Oct. 69: 64p., NTIS No. PB-195 930: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

9.0027, SANTA CRUZ COUNTY COOP

E.E. BRABB, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California.

This study is undertaken to provide basic data necessary to the preparation of the Seismic Safety Element of the Santa Cruz County General Plan. Since sufficient data is presently available regarding flood plains and areas susceptible to seismic sea waves, it is the purpose of this study to provide maps and interpretive text identifying the location and relative magnitude of geologic hazards due to seismic faults and landslide

related to land development, and will provide a means for broad evaluations of consultant reports in support of development projects. Additionally, the geologic information provided by the study will help in identifying or anticipating fault and landslide problems, and will thus indicate where special needs exist for further and more detailed investigations.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0028, EARTHQUAKE HAZARD REDUCTION, SAN FRANCISCO BAY REGION

E.E. BRABB, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California.

Identify, characterize and map the earthquake geologic hazards of the San Francisco Bay region. Develop criteria for recognition of geologic materials subject to landsliding, liquefaction and other ground failures resulting from earthquakes and refine techniques of estimating ground response to earthquakes for different geologic settings and seismic base motions. Prepare an active earthquake data system to compute local seismicity, ground base motion, natural period and amplification spectrum for ground materials, as well as probabilities of liquefaction, compaction, lateral spreading, landsliding and surface displacement along faults. This data system would provide the ability to quickly prepare and update regional or local seismic risk maps for planners and others concerned with earthquake hazards in the Bay region.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0029, GEOLOGY OF THE POINT DUME QUADRANGLE AND THE LOS ANGELES COUNTY PART OF THE TRIUNFO PASS QUADRANGLE, LOS ANGELES CO. COOPERATIVE, CALIFORNIA

R.H. CAMPBELL, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California.

The project has two basic objectives: (1) General-purpose geologic maps and sections at a scale of 1:12,000, with emphasis on identifying and evaluating potential geologic hazards. Mapping of Point Dume quadrangle is complete; mapping of Triunfo Pass quadrangle and topical studies continue. Landslide classification and characterization will be presented on slope maps at a scale of 1:24,000. (2) Geologic maps and sections at a scale of 1:24,000 combined with those of adjoining areas (see project 9550-00626), to form the basis of a comprehensive report on the geology of the central Santa Monica Mountains.

The project area is in the Santa Monica Mountains, northwest of the Los Angeles basin and southwest of the San Fernando Valley, both of which are densely urbanized. To the north and northwest lie the rapidly developing areas of southern Ventura County. There is much land-use planning by public and private agencies, and, as about 70 percent of the area slopes at 50 percent (26 degrees) or more, slope stability is a major concern.

In the project area, the mountains constitute a west-trending block of Late Cretaceous to middle Miocene sedimentary and volcanic rocks. Those strata were cut by gently dipping detachment faults and northeasterly-trending high-angle faults, and further disrupted by the forcible intrusion of basalt and andesite sills, all during middle Miocene time. The mountain block is now tilted northward, bounded on the

The Monterey Bay project is concerned with the geophysical and geological mapping of Monterey Bay, Monterey Canyon and fan, and the continental shelf and slope from south of Point Sur to Ano Nuevo Point in the north, along the central coast of California. Interpretation of the geophysical data which was collected by continuous marine seismic reflection profiling with a high resolution, .6 to 1 kj sparker, intermediate penetration, 13 to 33 kj sparker, high powered, 160 kj sparker, magnetic profiling with a marine proton precession magnetometer, and gravity profiling with a shipborne stable platform marine gravimeter, is being done presently. Interpretation of the geological data which consist of bedrock and sediment samples collected by dredging, gravity coring, vibracoring, and in situ sampling with a research submersible are continuing.

Principal objectives of this project are (1) to seismically map the geologic structures of Monterey Bay, to establish geology of the bay, its structure and tectonic history; genesis, thickness and depositional history of the sediments of the bay, (2) to determine the distribution and locations of fresh water aquifers in the northern portion of the bay, (3) to determine the origin of Monterey Submarine Canyon and its significance as it relates to the geology of the bay, (4) to map faults in Monterey Bay and along the shelf from Point Sur to Ano Nuevo Point and determine their significance as they relate to onshore geology, recent seismic events, and modern day working hypothesis such as sea-floor spreading, and (5) to delineate geologic hazards such as locations of slumps and possible submarine landslides. Areas of possible economical interests, such as sedimentary structures that may contain hydrocarbons and locations of possible commercially available sand and gravel deposits have been identified.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0031, ALASKA GEOLOGIC EARTHQUAKE HAZARDS

G. PLAFKER, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: Alaska.

The specific project objectives are to reduce and evaluate risk in Alaska from tectonic displacement, seismic shaking, and secondary geologic effects. A more general goal is to gain an insight into tectonic processes within the seismically active zone of southern Alaska.

Initially, research efforts will be concentrated in the highly seismic southern part of the State where most of the population and economic development are concentrated. This research will later be extended into the southeastern and central parts of the State. Geological research under this project will be closely coordinated with parallel geophysical projects by the Office of Earthquake Research.

The geologic studies will involve: 1) preparation of detailed maps of active surface faults and evaluation of geologic evidence for late Cenozoic fault movement; 2) delineation of coastal areas that may be subjected to major earthquakes characterized by large-scale regional tectonic elevation changes and assessment of the hazards related to such movements (notably seismic shaking, tsunamis, seiches, and regional warping); 3) identification and evaluation of secondary geologic hazards related to seismic shaking in critical areas of high population density and along transportation routes (such as landsliding, submarine sliding, liquefaction, landsliding and compaction), and 4) preparation (with OERCS) of a synthesis of pertinent data on the tectonic processes in the seismically active junction between the

within which earthquake hazards in southern California are evaluated.

SUPPORTED BY U.S. Dept. of Interior

9.0032, GEOLOGY OF THE POINT BLANCK, CALIFORNIA

J. SCHLOCKER, U.S. Dept. of the Interior, Menlo Park, California 94025

States to which project pertains: California.

The project objectives are to prepare a geology of the area in order to learn more about the geology and history of the bedrock crust which underlies the Franciscan Formation, and to aid in land use planning in the area. Considerable pressure for urban development has been applied recently, for this area is only 20 miles from San Francisco. Thus the sheared melange blankets and other geologic units such as the abundant, extensive Franciscan deposits and landslides will receive special attention. Radiolarian chert is especially thick and characteristic in the southern part of the quadrangle. They are composed of spilites and basalts will be the subjects of special study. The southern border of an extensive and important melange lies within the quadrangle underlying the up of radiolarian chert, sandstone and other rocks. The nature and origin of the melange will be determined by an intensive study of the border.

SUPPORTED BY U.S. Dept. of Interior

9.0033, ACTIVE FAULTS AND GEOLOGIC HAZARDS FROM PT. MUGO TO WILMINGTON, CALIFORNIA

H.C. WAGNER, U.S. Dept. of the Interior, Menlo Park, California 94025

States to which project pertains: California.

Topical studies related to earthquake hazards in California borderland, with geologic mapping as a by-product evaluation spinoff. Major objective of the project is to construct the depositional and structural sequence of the borderland in order to determine the age and kind of faults, and offshore faults as a means of evaluating earthquake hazards, tsunamis, landslides, or slumps which may relate to building construction or to major urban areas of high population growth. The geologic mapping will increase knowledge of offshore parts of the borderland and will provide a means of evaluating subsurface economic resources (e.g., oil, gas, phosphate, manganese, oil and gas).

SUPPORTED BY U.S. Dept. of Interior

9.0034, MALIBU BEACH QUADRANGLE, UNINCORPORATED PART OF QUADRANGLE, LOS ANGELES COUNTY, CALIFORNIA

R.F. YERKES, U.S. Dept. of the Interior, Menlo Park, California 94025

States to which project pertains: California.

The project area is centered in the largely undeveloped Monica Mountains, immediately northwestern edge of the urbanized Los Angeles basin, and is therefore of intensive land-use planning by public and private agencies. Part of the mountains is underlain by a complex of dipping detachment faults, thrust faults, and other distributed bodies of easily eroded igneous and metamorphic rocks. The faults. The mountains have been de-

sion, such that about 80 percent of the area is underlain by slopes exceeding 50% (26 degrees). These characteristics have contributed to the formation of numerous extensive landslides.

The primary objective is to prepare general-purpose geologic maps at a scale of 1:12,000 (now about 75% completed), emphasizing geologic hazards. The geologic maps will be followed by slope-analysis maps at 1:24,000, which will combine data on slope-forming processes on a base map that shows percent of slope within a narrow range, the boundaries of the slope intervals to be based on land-use and grading-code criteria. The geologic maps and sections at 1:24,000 will finally be combined with those of adjoining areas (see Project 9550-00634) to the basis of a comprehensive report of the geology of the central Santa Monica Mountains.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0035, REMOTE SENSING FOR GEOLOGIC HAZARDS AND DISASTERS, MINE AREA CONSERVATION, SOIL MAPPING AND LAND USE PLANNING

G. GOODWIN, U.S. Natl. Aero. & Space Adm., Ames Research Center, Moffett Field, California 94035 (747053)(1)

The objectives are: (1) to analyze landslides and other geologic structures prone to mass movement using an infrared radiation imaging system, and (2) to help solve specific problems of several State of California agencies by obtaining infrared imagery of water and land features, and assisting in image interpretation. Large scale imagery is required for detailed analysis and correlation with carefully completed field studies. To determine those factors that influence soil and water surface temperatures, low altitude flights on a diurnal and seasonal basis using an infrared line scanner will be made. ERTS-1 imagery will be used along with CV-990 and U-2 underflight missions. ERTS-B thermal imagery will be used when available.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

9.0036, DEFORMATION CHARACTERISTICS OF HILL SLOPES & CHANNELWAYS IN 2 DIFFERENT ENVIRONMENTS AS DEPICTED BY REMOTE SENSOR RETURNS - CALIFORNIA

D.H. POOLE, Univ. of California, School of Physical Sciences, Riverside, California 92502

Abstract: Two forms of rapid mass wastage, mudflow and debris slide, are considered. Both forms of movement are studied in their environment of occurrence using a remote sensing approach. The two environments included Wildwood Canyon watershed in California and Davis Creek watershed in Virginia. Data sources include standard black and white aerial photography, Aero Ektachrome, and Aero Ektachrome Infrared (CIR) photography. A comparison of mass wastage phenomena in the two areas reveals many similarities in form and between the physical character of the drainage ways. In Wildwood Canyon maximum deformation was limited to several small tributaries and the main channel. Both channel and widespread slope distortion occur throughout the Davis Creek drainage Basin.

Pub. Aug 72: 56p., NTIS No. AD-748 642: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Navy

9.0037, LIME SOIL STABILIZATION STUDY

effectiveness of lime treatment to stabilize embankments, landslides and soft foundation soils. A report on the literature search phase of the study has been prepared. Laboratory testing and field testing will be done. Reports issued. 'Lime Soil Stabilization Study', T. W. Smith, M. L. McCauley, J. Pilon, January 1967. 'A Study of Lime-Reactivity of California Soils by Electrical Dispersion Method', K. Arunkandan, C. K. Shen, University of California Interim Report, November 1968.

Document provided to SSLE By the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

9.0038, EVALUATION OF 'ION EXCHANGE' LANDSLIDE CORRECTION TECHNIQUE - CALIFORNIA

T.W. SMITH, State Div. of Highways, Sacramento, California 95814

The ion exchange technique, a chemical landslide correction measure, has been used on a landslide in northern California. The project will provide data on the landslide, the method of treatment, and evaluate the results of the treatment in terms of stabilizing the slide.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

9.0039, EVALUATION OF THE ION EXCHANGE LANDSLIDE CORRECTION TECHNIQUE

R. MEARNS, State Materials & Res. Dept., Sacramento, California

Abstract: A technique for correcting landslides using a chemical treatment is discussed. Treatment of a specific landslide using the technique is described. The results of a monitoring program to determine the effectiveness of the treatment are presented and analyzed. The technique appears to be theoretically sound. Treatment of the landslide was simple and relatively inexpensive. The slide now appears stable, but this condition cannot be clearly attributed to the chemical treatment. Future use of the technique is recommended.

Pub. Jan 73: 37p., NTIS No. PB-220 370/1 PC \$3.75 MF \$0.95.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

9.0040, SOCORRO 2 DEGREE QUADRANGLE - NEW MEXICO

G.O. BACHMAN, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

The geology of the Socorro 2 degree quadrangle in central New Mexico is being compiled at a scale of 1:250,000. The principal objective is to provide a geologic base for a continuing study of the environmental geology of the region. This is part of a larger project to study the central Rio Grande trough in areas of major population centers. Emphasis is being placed on geologic studies of the Cenozoic fill within the trough where recent faulting, slope stability, ground and surface water, and waste disposal problems require geologic background for potential land use.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0041, GEOLOGY OF THE RAPID CITY AREA, SOUTH DAKOTA

J.M. CATTERMOLLE, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States in which project pertains: South Dakota

1:24,000. The maps of the Rapid City West and Rapid City East have been published in the Geologic Quadrangle Map Series in full color with a columnar section and text; the map of the Rapid City NW quadrangle was scheduled to be printed in 1973 and should be released early in 1974.

The final product of the project is a two part Bulletin covering the entire urban area of Rapid City: the first part will describe the geology, structure and stratigraphy of the three quadrangles; the second part will detail foundation conditions, expansive soils, construction materials, landslides, and physical characteristics of each formation and the pertinent effects related to planning engineering projects.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0042, DENVER METROPOLITAN AREA, COLORADO
R.M. LINDVALL, U.S. Dept. of the Interior, Geological Survey,
Denver, Colorado 80225

States to which project pertains: Colorado.

The project objective is to prepare detailed general-purpose geologic maps of eight quadrangles covering the major part of the Denver metropolitan area. These maps, at a scale of 1:24,000, are designed to provide basic information on the geologic factors pertinent to maximum utilization of land in a rapidly expanding area of urban development. Information to be provided concerns the engineering properties of the surficial and bedrock units, location of potential hazards such as landslides, areas subject to flooding, areas subject to possible earthquake damage, areas of poor foundation conditions, and the location and extent of sand and gravel deposits necessary for construction aggregate materials.

The geologic maps, each including a brief descriptive text, are to be released first in open files and subsequently published in the Geologic Quadrangle Map Series. The geologic map of the Parker quadrangle was published in 1972 as the first sheet in a special Folio of the Parker quadrangle. Thirteen additional single-concept maps of the quadrangle have been or will be published in the near future to complete the Folio. The enthusiastic acceptance of the Parker Folio by planning commissions and public officials have prompted plans to issue some similar interpretive maps for the adjoining Highlands Ranch quadrangle.

A comprehensive geologic report covering all eight quadrangles is planned for the Bulletin series.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0043, SURFICIAL GEOLOGY OF JUNEAU AND VICINITY URBAN AREA, ALASKA

R.D. MILLER, U.S. Dept. of the Interior, Geological Survey,
Denver, Colorado 80225

The Juneau project started as part of a coastal communities program of earthquake hazard studies following the March 1964 Alaska earthquake. The original primary objective was to investigate and evaluate potential hazards from earthquakes as a result of the geologic setting. The study has been broadened to include other natural geologic events and to try and relate man's use of the land to the existing geologic environmental conditions. Field mapping was completed in 1971.

The project consists of differentiating and mapping surficial deposits and performing physical properties tests on selected samples. Development of raised marine and glaciomarine deposits, glaciofluvial, glacial, and lacustrine deposits is coupled to the geologic history, which in part influences the dis-

development to helpfully avoid geologic pitfalls into account the geologic influence on the environment as relative stability of deposits in case of severe earthquakes, areas of known or potential rockfalls and avalanches, and bearing foundation conditions.

A geologic map with text and interpretive transparency was released to open file in May 1972. A U.S. Survey Bulletin, 1394-C, was published in 1973 that describes the glaciomarine deposits and formation name, the Gastineau Formation. A geologic map with tabular text processed for publication in the Miscellaneous Investigations Map series of the Geological Survey.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0044, DENVER-FRONT RANGE URBAN CORRIDOR
T.W. OFFIELD, U.S. Dept. of the Interior, Geological Survey,
Denver, Colorado 80225

States to which project pertains: Colorado.

Application of remote-sensing techniques in the Front Range area Colorado includes delineation of geologic structure and landslide hazards by use of thermal-infrared discrimination of rock types, alteration areas, and in mineral districts by use of aircraft and satellite remote data, and laser filtering of photographic images for enhancement of linear structure elements.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0045, MOUNTAIN SOILS, FRONT RANGE URBAN CORRIDOR

K.L. PIERCE, U.S. Dept. of the Interior, Geological Survey,
Denver, Colorado 80225

States to which project pertains: Colorado.

The prime objective is to prepare maps showing distribution, thickness, and infiltration characteristics of the mantling hard crystalline rock in the mountainous Front Range Urban Corridor. The map units will be used to provide information concerning the suitability of regolith (soil) for disposal of septic tank effluent waste, surface or ground water contamination, and the development possible by power machinery without rock blasting. Also mapped (with Water Resources Division) will be the areas affected by flash floods, seasonally saturated ground, and landslides.

Mapping will be done for publication at a scale of 1:24,000 in a period of about 2 years. Water-well logs and seismic system will be used to gain information on the character and thickness of the regolith.

Scientific benefits will include a better understanding of the geomorphic history of the region, and the nature of the geologic setting on terrains of different age and different rock types.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0046, SNAKE RIVER BASIN, PART F - SOUTHWESTERN PART, NORTHWEST MARGIN - IDAHO

B. SKIPP, U.S. Dept. of the Interior, Geological Survey,
Denver, Colorado 80225

The project involves the mapping, to be compiled at a scale of 1:250,000, of all or parts of thirty 7 1/2 quadrangles, situated in the southwestern part of the northwest flank of the Snake River plain. The chief objectives are: (1) the mapping of the little known Late Paleozoic rock sequence and stratigraphic and paleogeographic studies; (2) the de-

flows along the north edge of the Snake River Plain; (4) the providing of a geologic framework for environmental studies in the region; (5) the study of recent faulting and landslide distribution possibly related to earthquake activity; and (6) the supplying of a well-mapped area adjacent to Snake Plain which will aid in interpretation of gravity and aeromagnetic surveys across the plain.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0047, EVALUATION OF CRITERIA FOR LANDSLIDE ANALYSIS AS PRESENTED IN THE U.S.G.S.

UNKNOWN, U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado 80225

Abstract: A landslide investigation was made of Lake Roosevelt during the period April 28 to 30, 1969. Upon completion of the inspection trip, the Project was requested to investigate the reliability of empirical criteria established by former Project Geologist, Mr. F.O. Jones, for evaluating landslides. Fifty-four areas were selected for evaluation by applications of Jones' empirical equations (location map, page 4). Thirty are active landslide areas, some of which have developed since the Jones study was made. Eighteen locations are considered potential landslide areas. Six areas which appear stable were selected as a check against the empirical predictions. The fifty-four locations selected are considered representative of the reservoir rim.

Pub. Jan 70: 29p., NTIS No. PB-194 680: IIC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Interior - Bn. Reclamation

9.0048, HAMILTON 2 DEGREE

J.D. WELLS, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Montana and Idaho.

Prepare a geologic map of the Hamilton 2-degree sheet at 1:250,000 scale, integrating the past, current, and future pertinent mapping done by industry, universities, and State and Federal agencies, and incorporating geologic, geochemical, isotopic, and geophysical data as a basis for evaluation of land use and mineral potential. Special purpose interpretative maps and reports will be prepared of appropriate areas where potential hazards such as landslides, unstable foundation material, faulting, earthquakes, and flooding are present. An evaluation of known and potential mineral resources of base and precious metals and fluorite along the margins of the Idaho Batholith and stratabound copper in the Beltian strata will be made. These data will contribute to the general body of geologic knowledge of the northern part of the Idaho Batholith and contribute in developing the regional structural, stratigraphic, magmatic, metamorphic, and erosional patterns. They will further provide a proper basis for land use planning for the diverse interests in this area of urban development in an outstanding recreational area.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0049, PROGRAM DESIGN-1971 - SAN FRANCISCO BAY REGION ENVIRONMENT AND RESOURCES PLANNING STUDY

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Abstract: A comprehensive guide to a study of the 9-county San Francisco Bay Region describes a 4 year research program, the study conducted initially by the Geological Survey.

faults and earthquake hazards, landslides and slope instability, physical and chemical properties of San Francisco Bay and its circulation patterns, water-quality and pollution, areas subject to flooding, water supply and waste-disposal systems, and available mineral and water resources. Planning program elements described include state-of-the-art review and analysis, a feasibility study of incorporating earth-science data into urban planning information systems, and application and demonstration studies.

Pub. Oct. 71: 121p., NTIS No. PB-206 826. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

9.0050, REMOTE SENSING APPLICATIONS IN HYDROLOGY AND GEOLOGY

J. DENOYER, U.S. Natl. Aero. & Space Adm., Headquarters, Washington, District of Columbia 20546 (7370892)

These studies will determine the potential applications of the present state-of-the-art of remote sensing to the Army Corps of Engineers mission. The disciplines involved are geology, biology, ecology, estuarine processes. Activities include vegetation classification, chemical and thermal pollution analysis, river turbulent cell analysis, determination of surface and subsurface geologic conditions, location of landslide prone areas, analysis of sediment deposition, siting of potential project locations, identification of land use patterns, ocean circulation tidal currents and tidal flushing, and monitoring the impact of construction on the surrounding environment. It is reasonable to assume that color, IR, and multispectral photography, and SLAR and scanner imagery from aircraft, can significantly enhance existing data, thereby expanding the basis for water resources management decisions.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

9.0051, EFFECTS OF DEFORESTATION ON THE STABILITY OF NATURAL SLOPES - OREGON, WASHINGTON

D.H. GRAY, Univ. of Michigan, School of Engineering, Ann Arbor, Michigan 48106

The broad objective of this study is to examine the extent to which deforestation and current logging practices affect slope stability on steep, mountain sites. This approach differs from studies commonly undertaken which have chiefly investigated the effects of forest practices on surface runoff, soil erosion and subsequent productivity.

Specific objectives are as follows: 1. To determine to what extent removal of the forest cover affects the following physiographic and soil property variables: A. Soil moisture stress, b. Soil shear strength, c. Creep susceptibility; d. Slope surcharge. 2. To determine how and to what extent changes in the above variables affect the deep seated stability of a slope by calculating and measuring: a. Factors of safety against sliding, b. Soil mantle creep rates.

Steep slopes in two watersheds in the H. J. Andrews Experimental Forest in the Cascade Range of Central Oregon have already been instrumented. In addition, it is planned to instrument three sites on slopes of the Cascade Ranges of Washington.

SUPPORTED BY U.S. Natl. Science Foundation

9.0052, EFFECTS OF FOREST CLEAR-CUTTING ON THE STABILITY OF NATURAL SLOPES

forest cover appears to affect the deep seated stability in two principal ways, viz., by modifying the hydrologic regime in the soil mantle and by mechanical reinforcement from its root system. This report describes a theoretical stability analysis which should make it possible to predict the stability of a forested slope and assess the probable consequences of denudation on a more rational basis. A field study presently being conducted in central Oregon is also described. Slopes have been instrumented there in order to obtain quantitative data on soil moisture stress and soil mantle creep before and after clear-cutting.

Pub. Sep 69: 74p., NTIS No. PB-191 635: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Natl. Science Foundation

9.0053. ACKER LAKE LANDSLIDE, MONROE COUNTY, MISSISSIPPI

D.M. KEADY, State Geol. Survey, Jackson, Mississippi

Abstract: Mass wasting in the Tumbighee Sand Member of the Eutaw Formation (Upper Cretaceous) is not an uncommon occurrence on steep bluffs developed on this unit in northeastern Mississippi. The most recent documented slide occurred on Monday, April 27, 1970, in the vicinity of the small man-made Ackers Lake, approximately five miles (8 kilometers) north of Aberdeen. This report is a description of the slide and an interpretation by the authors of the factors involved in its development.

Pub. 1973: 24p., NTIS No. PB-228 697/9: PC \$4.25 MF \$1.45.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

9.0054. ROCK STRENGTH FROM FAILURE CASES

J.F. REDLINGER, U.S. Army, Missouri River Engr. Div., Omaha, Nebraska

The purpose of this research is to obtain needed information on reliable values of shear strength of in-situ rock masses for use in design problems involving high rock slopes, rock bolting treatments, sliding of structures on rock foundations, tunnel and portal stability problems, etc. The record of past rock slope failures indicates that these failures have been controlled by the strength of key rock defects (joints, weak seams, faults, etc.). A related laboratory study at MRD has succeeded in developing techniques to appraise the frictional contribution to joint strength (or other defect) and in pointing up the importance of this additional strength or 'cohesion contribution' that results principally from the degree of roughness or interlocking of the joint surface. Studies by Patton at the University of Illinois, and views frequently voiced at the 1966 International Rock Mechanics Congress in Portugal and subsequent symposia in the U.S., have emphasized the severe lack of information regarding this cohesion contribution and strongly suggest that it may be best appraised after backfiguring rock failures for stresses acting in-situ at time of the failure.

Plans for the immediate future include a field study of known rockslides to determine slope geology, geometry and ground water conditions, failure mass geometry, and movement history. The study will be conducted in two areas: (1) hard rock slopes, and (2) soft rock slopes. Shear strength parameters will be calculated for the limiting equilibrium conditions of the failure masses. The strength parameters obtained in this manner are to be applied as guidelines in the design of stable slopes in rock.

SUPPORTED BY U.S. Dept. of Defense - Army

This research project seeks to understand variations in tree-ring growth in trees on certain debris slides in the High Plateaus of Utah and to relate these variations to slope movement patterns. Narrow growth rings produced by tilting and by trauma of root shear will be related to movement determined by other methods, such as aerial photographic analysis of the debris slides. Minor ecologic and climatic factors affecting tree-ring characteristics are expected to be removed by reference to a control group of trees growing on nearby stable slopes. Tree-ring data from trees with disturbed growth will be treated statistically and computer maps generated to display tree locations at different points of time, hopefully resulting in a slope movement chronology that can be tied solely to tree-ring growth information. The patterns of movement and dating of events by tree-ring methods may allow inferences as to whether surge mechanisms operated within the debris slides.

SUPPORTED BY U.S. Natl. Science Foundation

9.0056. THE INFLUENCE OF CLAY MINERALS ON SURFICIAL EARTH MOVEMENTS

P.F. KERR, Columbia University, School of Arts, New York, New York 10027

Abstract: The report is a condensed summary based on studies extending over 10 years and covered by 16 publications. Mention is made of the clay-water situation, the role of clay minerals in landslide formation, the range of speeds in landslide movement, the fluid movement of clay (thixotropy), and underflow in landslides. Discussion is included on theories of landslide origin.

Pub. Mar 72: 24p., NTIS No. AD-766 209/1: PC \$2.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Air Force

9.0057. LANDSLIPS IN SOUTHEASTERN OHIO

K.R. EVERETT, Ohio State University, School of Agriculture, Columbus, Ohio 43210 (OHIO00401-S)

Objective: Apply information obtained at EORDC on landslip environment, mechanisms, rates and pattern of movement to a broader area of SE Ohio. Investigate relationships between landslips and landuse and develop regionally applicable recommendations for their control.

Approach: Areas of farm slope instability will be plotted on topographic maps and/or air photos to determine actual acreages affected in Noble and adjacent counties. As many of these areas as practicable will be examined to substantiate similarities or departures in form and mechanics from those studied at EORDC. Past and present landuse practices which may have contributed to such mass-movements will be evaluated and amendment recommendations formulated. A number of forested slopes will be studied to finally evaluate the value of reforestation in stabilizing the slopes of SE Ohio.

Progress: A final report covering results from 1967 through 1972 was prepared and submitted to OARDC in June 1972 under the title 'Slope Movement and Form in Southeast Ohio'. Vertical velocity profile cylinders inserted in the slope at site 2 in July 1971 were excavated in November 1972. Plots of these cylinders indicate both creep and shear motions have occurred and their amount is in close agreement with measured surface velocities and microtopography. Regional documentation of landslips in Noble county from air photographs has been initiated.

SUPPORTED BY Ohio State Government - Columbus

9.0058, DEVELOPING REMOTE SENSING TECHNIQUES FOR AIDING PREDICTION OF LANDSLIDES**O.W. MINTZER**, Ohio State University, School of Engineering, Columbus, Ohio 43212

The objective of this investigation is to develop applications of remote sensing techniques for locating incipient landslides and forecasting conditions relative to occurrence. Procedures: The data are to be collected by means of ground and aerial surveys. Soil and rock samples along with moisture content to appropriate depths are to be collected. Color photography and thermal infrared imagery are to be collected on a pre-arranged schedule coordinated with ground data collections. These data combined with the correlative geologic, soil, topographic and drainage features will be analyzed in order to guide the study of conditions that cause landslides. Progress: The initial phase of establishing regions (sites) where the investigation will be concentrated are nearing completion. Selection of remote sensing techniques for use in the study is complete. Establishing the appropriate correlative procedures is in progress.

SUPPORTED BY Ohio State University**9.0059, STABILIZATION OF STEEP LAND SLOPES - OHIO****G.O. SCHWAB**, Ohio State University, School of Agriculture, Columbus, Ohio 43210

Objective: To determine identifying potential landslide areas from simple soil and topographic characteristics. To develop and evaluate methods for stabilizing land slopes by such practices as diversion channels, surface drains, subsurface drains, and vertical wells.

Approach: Analytical, model, and field studies will be conducted to develop practical and economical measures and methods to reduce or to stabilize potential or existing landslides in southeastern Ohio. Detailed field measurements will be made at selected sites on the Eastern Ohio Resource Development Center. Proposed solutions will be developed primarily from laboratory and analytical models. Drainage designs which appear promising will be installed at field sites. Soil, topographic, and other features will be related to control measures. Basic information for extending recommendations to similar areas will be developed by coordinating the results with those from State Project 401.

Progress: Measurements were made on concrete bench marks installed on or near the bench terrace which was constructed in 1969. Soil movement horizontally and vertically was insignificant during the previous year. About 2,100 feet of two-inch diameter plastic drain tubing was installed on two hill-sides at the Eastern Resource Development Center near Caldwell. The drains were installed with a mole plow at a depth of about two feet on slopes which showed evidence of considerable soil movement. Twenty-two bench marks were installed to measure horizontal and vertical soil movement. These benchmarks were constructed by placing 4 feet of 2-inch diameter plastic tubing in a 6-inch post hole and filling the space with sand.

SUPPORTED BY Ohio State Government - Columbus**9.0060, ENVIRONMENTAL INFLUENCES ON STABILITY OF SOIL MASSES - ALASKA AND OHIO****T.H. WU**, Ohio State University, School of Engineering, Columbus, Ohio 43212

dy. Soil tests will be conducted in the field and in the laboratory.

SUPPORTED BY U.S. Natl. Science Foundation**9.0061, MEASURE AND DEPICT TROUBLE AREAS IN STEREO-MODELS - OHIO****W.F. NORELL**, State Dept. of Transportation, Columbus, Ohio 43215

Stereo photo keys are being developed for the use of stereoplotter operators in detecting and mapping the following foundation problem areas: landslides, landform voids due to mining, soft foundations, sinkhole topography, lacustrine deposits. Reports issued: 'Air Photo Patterns of Landslides In Southeastern Ohio', W.F. Norell, January 1966. 'Coal Outcrop and Overburden Mapping with Kelsh Plotter', W.F. Norell, Highway Research Record No. 109. 'Air-Photo Patterns of Subsurface Mining in Ohio', W.F. Norell, December 1968. 'Ohio Photogrammetric Research Solves Highway Foundation and Right of Way Problems', Digest of Third Interim Report of Research by Wayland F. Norell, Public Roads, Vol. 36, No. 9, August 1971.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.**9.0062, EROSION AND SEDIMENTATION FOLLOWING ROAD CONSTRUCTION AND TIMBER HARVEST ON UNSTABLE SOILS IN THREE SMALL WESTERN OREGON WATERSHEDS****R.L. FREDRIKSEN**, U.S. Dept. of Agriculture, Pac. N.W. For. & Rg. Exp. Sta., Portland, Oregon 97208

Abstract: In two steep headwater drainages, landslides were the predominant source of increased sedimentation of streams following timber harvest. Patch-cut logging with forest roads increased sedimentation compared with a control by more than 100 times over a 9-year period. Landslide erosion was greatest where roads crossed high gradient stream channels. In an adjacent clearcut watershed with no roads, sedimentation increased three times that of the control.

Pub. 1970: 19p., NTIS No. PB-194 987; MF \$0.65.

SUPPORTED BY U.S. Dept. of Agriculture**9.0063, DEVELOPMENT OF CRITERIA FOR RECOGNIZING & IDENTIFYING SLOPE FAILURE FORMS AS DEPICTED BY REMOTE SENSOR RETURNS - NORTH CAROLINA****D.H. POOLE**, East Tenn. State University, Remote Sensing Institute, Johnson City, Tennessee 37602

Abstract: The study shows that the criteria developed from photographic images depicted by remote sensing photography from NASA's North Carolina Test Site is based largely on pattern, color contrast, and geometric form. Patterns are best reflected in the erosional forms of sheet wash, rill wash, and gullying, and in the mass wastage forms of soil creep and rock fall and rock creep. Color contrast is significant in differentiating all erosional and mass wastage forms of slope failure. The color contrast between an object and its background is frequently the only means of establishing recognition. Geometric form is relied upon most often in recognizing and establishing the identity of the rapid forms of

bumps, 2) Investigate the possibility of employing a surface or near-surface detector network, 3) Determine the ability of the abutment pillar in relation to encroachment of final mining, and 4) Relate the 'noise' generated by subsidence to stress concentrations and variations in the strength of the overlying strata.

SUPPORTED BY U.S. Dept. of Interior - Bureau of Mines

10.0007, ROCK MECHANICS STUDY OF SHORTWALL MINING - KENTUCKY

F.D. WRIGHT, Univ. of Kentucky, School of Engineering, Lexington, Kentucky 40506

The purpose of this study is to measure subsidence and relate ground movements and ground pressures resulting from shortwall mining of coal to the physical properties and geologic structure of the coalbed and enclosing strata. These relationships will be analyzed in an attempt to develop methods for predicting the effects of shortwall mining on ground behavior under varying physical conditions. The work will include complete physical property testing of all samples and drill cores, complete instrumentation, monitoring and data collection at two underground test sites, drilling and instrumentation of vertical boreholes, and the reduction of all data collected.

SUPPORTED BY U.S. Dept. of Interior - Bureau of Mines

10.0008, STATUS OF LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL IN MISSISSIPPI

D.M. KEADY, Mississippi St. University, School of Arts, State College, Mississippi 39762

The objective of this study is to determine the status of subsidence due to ground-water withdrawal in the Mississippi Gulf coastal area. Areas where subsidence is suspected will be examined for evidence of subsidence, such as changes in elevation of well established bench marks and features produced by subsidence. Recommendations will be made concerning future development of ground-water supplies in areas where subsidence may pose problems.

SUPPORTED BY U.S. Dept. of Interior - G.W.R.T.

10.0009, DETECTION OF SUBSURFACE OPENINGS - INDIANA, MISSOURI

E.R. BATES, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Purpose of study/investigation: To develop a method for locating and delineating solution phenomena (cavities, sinks, joints, etc.) in karstic terrain.

Approach or plan: Assess existing and remote sensing capabilities and limitations by means of performance tests and evaluations of new and prototype equipment. Restrictions or limitations of specific techniques will be evaluated as to effective penetration distances and resolution capabilities.

Progress to date: An extensive literature survey revealed that electrical resistivity (Bristow method) offered the most promise for detecting subsurface openings. Good results were obtained detecting air-filled cavities using the Bristow method in the karst area of Indiana. It was also determined that the lapies and grike structure common to this area (Indiana) presented problems of interpretation that required revisions in procedures for analyzing the data. Resolution and effectiveness of modified (Bristow) techniques and analysis

10.0010, STUDY OF GROUND SHOCK INDUCED LIQUEFACTION AS A MECHANISM FOR FAILURE OF MILITARY INSTALLATIONS

J.G. JACKSON, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

To determine the effect of percent saturation on wave propagation phenomena in sands, in order to assess the effect of the presence of groundwater on free field stresses and motions caused by a nuclear blast, and to investigate liquefaction potential of soils under the combination of outrunning and locally airblast-induced ground shock. Ground shock due to earthquakes has caused the failure of conventional structures by liquefaction (the formation of a quick-sand conditions), the potential of nuclear blast induced ground shock for causing failure of military installations will be investigated. The relevance of this work is the use of its results for construction of protective structure facilities to prevent such failures and in target analyses as a means of destroying enemy facilities.

A series of wave propagation experiments will be conducted on a medium dense sand in the small blast load generator in which the percent saturation, groundwater table position and initial pore pressure will be varied to determine the effect on free field stress and motion, when high intensity airblast surface loading pulses and low frequency oscillatory base motions are applied to the soil specimens. Movement of inclusions covering a wide range of density will be monitored in order to detect any tendency for liquefaction to occur. If possible, an experiment will be designed for a future H.E. field test.

Supporting agency address information: OCE Waterways Experiment Station, Vicksburg, MI. 39180

SUPPORTED BY U.S. Dept. of Defense - Army

10.0011, LAND-SURFACE SUBSIDENCE, BAYTOWN AREA, TEXAS

R.K. GABRYSCH, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

Purpose: The objective of this study is to determine rates and amounts of subsidence and to predict the rate and amount of subsidence for planning, construction, and maintenance of the proposed levee or some other protective measure.

Methods: Data on the relation of pressure decline to compaction would be collected and form the basis for determining the amount and rates of subsidence. These data include inventories of ground-water pumpage and oil and gas production and delineation of pressure decline due to each. A study would be made of the sub-surface deposits with the use of drillers' and electrical logs to determine clay and sand-bed thicknesses and composite clay thickness. Ten wells would be drilled to obtain clay cores, to install core pressure measuring devices in clays, to measure pressure heads in sands, and install compaction monitoring equipment. Water-level measurements would be obtained to relate with data from a releveling program initiated by the Corps of Engineers.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0012, LAND-SURFACE SUBSIDENCE, TEXAS CITY AND SEABROOK AREAS, TEXAS

R.K. GABRYSCH, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

Purpose: The Corps of Engineers, in their concern for losses caused by hurricane flooding, has developed protection

gineers began structures in areas of subsidence. Because of the magnitude and rates of subsidence shown by periodic leveling (1943, 1954, 1959, 1964, and 1971) in some areas, it has become more important than ever to consider subsidence. The objectives of this study are to predict amounts and rates of subsidence for planning, constructing, and maintaining the levees and holding ponds used for protection.

Methods: Existing data on geology, hydrology, groundwater, and oil production, water levels and declines in water levels, would be collected and analyzed. Undisturbed samples would be taken from test holes and analyzed for consolidation characteristics and permeability. Observation wells would be installed to determine existing pressure profiles and reaction with time. Borehole extensometers would be constructed. Compaction of the top 1,500 feet of material would be monitored at the Seabrook site and of the top 900 feet at the Texas City site.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0013, CONTINUING QUANTITATIVE GROUND-WATER STUDIES IN THE HOUSTON DISTRICT

A.G. WINSLOW, U.S. Dept. of the Interior, Geological Survey, Austin, Texas 78701

Purpose: To continue with appropriate modifications of the basic data collection program of the aquifers underlying the Houston district and thus provide the area with current, up-to-date information on its ground-water resources.

Methods: Operate and maintain ground-water level and subsidence network as follows: Observation wells, 6 recorder, 500 non-recorder; 1 compaction recorder. Conduct pumping tests on new large-capacity wells; conduct inventory of annual municipal, industrial, and irrigation pumpage; collect 92 water samples for chemical analysis; continue preparation of well-inventory records for publication; and analyze, interpret, and correlate all data collected with previously collected data.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

HAZARD REDUCTION

10.0014, ARIZONA EARTH FISSURE INVESTIGATION

C. WINIKKA, State Highway Department, Phoenix, Arizona 85007 (2R63206094)

Land subsidence, which is occurring in agricultural areas of Arizona due to declining levels of groundwater, is causing the formation of numerous earth fissures. Very little information has been recorded concerning these fissures which generally occur in the desert adjacent to the agricultural land. Fissures exist across interstate highways, railroads, in improved areas, and in cultivated land. Aerial photography, field inspections, analysis of level lines, and ground water levels are being studied to define the extent of the problem.

Document provided to S.S.I.F. By the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - FHWA

10.0015, MASS PROPERTIES OF OIL FIELD ROCKS - CALIFORNIA

L.A. BEYER, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

Research with the aid of borehole gravity density and porosity logs: (1) comparisons with core analyses, gamma-gamma logs, sonic or acoustic logs and well velocity surveys; (2) various geologic problems including causes of anomalous low density shales, density variations associated with thrust or reverse faulting, basement fault and basin definition, and oil dome exploration; (3) relationships between lithology, petrophysical characteristics, oil and gas accumulations, and post-depositional history of sedimentary rocks in selected U.S. oil fields; (4) the interpretation of surface gravity maps and seismic surveys; (5) the study of ground water systems and ground subsidence due to fluid withdrawal; (6) the engineering systems and ground subsidence due to fluid withdrawal; (6) the engineering properties of surficial sediments.

Research and development of borehole gravity instrumentation: (1) miniaturized borehole gravimeter, (2) borehole gravity gradiometer.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0016, ALASKA GEOLOGIC EARTHQUAKE HAZARDS

G. PLAFKER, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: Alaska.

The specific project objectives are to reduce and evaluate risk in Alaska from tectonic displacement, seismic shaking, and secondary geologic effects. A more general goal is to gain an insight into tectonic processes within the seismically active zone of southern Alaska.

Initially, research efforts will be concentrated in the highly seismic southern part of the State where most of the population and economic development are concentrated. This research will later be extended into the southeastern and central parts of the State. Geological research under this project will be closely coordinated with parallel geophysical projects by the Office of Earthquake Research.

The geologic studies will involve: 1) preparation of detailed maps of active surface faults and evolution of geologic evidence for late Cenozoic fault movement; 2) delineation of coastal areas that may be subjected to major earthquakes characterized by large-scale regional tectonic elevation changes and assessment of the hazards related to such movements (notably seismic shaking, tsunamis, seiches, and regional warping); 3) identification and evaluation of secondary geologic hazards related to seismic shaking in critical areas of high population density and along transportation routes (such as landsliding, submarine sliding, liquefaction, landspreading and compaction); and 4) preparation (with OERCS) of a synthesis of pertinent data on the tectonic processes in the seismically active junction between the transform fault system in southeastern Alaska and the northern extension of the Aleutian arc tectonic regime into south-central Alaska, to provide a broad framework within which earthquake hazards in southern Alaska can be evaluated.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0017, SUBSIDENCE AND RELATED ASPECTS OF GEOTHERMAL SYSTEMS

B.E. LOFGREN, U.S. Dept. of the Interior, Geological Survey, Sacramento, California 95814

Subsidence and ground movement frequently accompanies the intensive withdrawal of formation fluids. These effects are

To measure the stress-strain parameters of these areas, and relate them to the extraction and injection of geothermal fluids is of major concern in the exploitation of geothermal fields.

To conduct research on vertical and horizontal displacements and land-surface changes caused by geothermal extractions, fluid injections, induced subsurface pressure gradients, and formation temperature changes, to differentiate displacements and changes caused by geothermal development from those related to tectonic and near-surface effects; to analyze and interpret pertinent hydrologic, geodetic, geophysical, and geologic data as a background for this investigation, and attempt to relate geothermal changes to the regional geology; to obtain stress-strain parameters of the geothermal system.

In cooperation with other agencies, establish a network of bench marks around centers of geothermal extraction and injection. These to be accurately surveyed periodically to measure horizontal and vertical movement. Determine stress-strain parameters of the geothermal system, and relate these to fluid and heat withdrawals. Relate surface movements to microearthquake and geophysical data, and attempt to define the mechanics of the subsurface geothermal system.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0018, LAND-SUBSIDENCE STUDIES IN CALIFORNIA - TO STUDY THE EXTENT, MAGNITUDE R

J.F. POLAND, U.S. Dept. of the Interior, Geological Survey, Sacramento, California 95814

In numerous areas of severe ground-water overdraft, effective overburden stresses are increased as much as 50 percent, causing significant compaction of the aquifer system and consequent subsidence of the land surface. These changes create economic and engineering problems in the operation of the ground-water basins and in construction and maintenance of water-transport structures - especially major canals. Stress increases in an artesian system result from either a reduction in artesian head or a rise in the overlying water table.

To study extent, magnitude, rates, and causes of land subsidence in California, to furnish criteria for estimating the amount of subsidence that would occur under assumed hydrologic change, to determine whether subsidence is reversible in part and to suggest ways for stopping or ameliorating subsidence.

Detailed study of areas of active subsidence in California, relating measured subsidence and compaction or expansion of the aquifer system to the pertinent hydrologic and geologic parameters. Compaction and water-level recorders or gages are maintained at about 30 sites. Subsidence and rate maps prepared for periods between available leveling data. Laboratory testing of core samples to obtain hydrologic and engineering properties of aquifer systems. This is a companion project to mechanics of aquifer systems research project PC-57-075-F.

Based on the 1970 leveling in the southern San Joaquin Valley by the NOS (formerly C&GS), we prepared subsidence maps that indicated maximum subsidence of 3.0 feet, 1962-70, in the Tulare-Wasco area, and of 2.2 feet, 1965-70, in the Arvin-Maricopa area. We computerized the processing and plotting of compaction and water-level (stress-change) data, began reconnaissance subsidence investigations of the Sacramento Valley and the Oxnard-Ventura area, and completed an appraisal of potential subsidence under as-

Los Banos-Kettleman City area by the NOS, and prepare preliminary subsidence maps from the unadjusted data; and continue subsidence studies in the Sacramento Valley, the Oxnard-Ventura area, and the San Jacinto Valley.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0019, LAND SUBSIDENCE STUDIES IN THE SAN JOAQUIN VALLEY - CALIFORNIA

J.F. POLAND, U.S. Dept. of the Interior, Geological Survey, Sacramento, California 95814

Objectives of this project are to study the extent, magnitude, rate, and causes of land subsidence in the San Joaquin Valley, Calif., to furnish criteria for estimating the amount of subsidence that would occur under assumed hydrologic change, to determine whether subsidence is reversible in part, and to suggest ways for stopping or ameliorating subsidence.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0020, DENVER URBAN CORRIDOR STUDIES - COLORADO

W.R. HANSEN, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

Project intends to derive maximum possible geotechnical information from existing available data, supplemented by areal, engineering geologic, hydrogeologic, geochemical, and geophysical studies. Geotechnical maps will be prepared at scales ranging from 1:125,000 to 1:24,000. Project covers virtually all the rapidly urbanizing area at the foot of the Front Range, and the rural areas between, from Fort Collins on the north to Colorado Springs on the south - a distance of about 120 miles, in a belt 40 miles wide extending from the foothills east across the Colorado piedmont. This is one of the fastest growing regions in the Nation. It contains a broad spectrum of geotechnical problems, such as swelling and subsiding foundation soils related to clayey and loessial substrates, declining artesian water pressures, shallow and rising water tables, increasing urban runoff, surface- and ground-water pollution, unstable slopes (landslides), declining gravel resources, urban sprawl across varied geologic terraces, solid waste disposal problems, and general environmental degradation. Project hopes to point up ways to help alleviate most of these problems through wise land-use planning and implementation.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0021, ENGINEERING GEOLOGY RECONNAISSANCE STUDIES OF COASTAL COMMUNITIES, ALASKA

R.W. LEMKE, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Alaska.

Reconnaissance engineering geology studies, directed principally toward assessing potential earthquake and other geologic hazards, have been completed in the following Alaska coastal towns: Skagway, Haines, Sitka, Ketchikan, Metlakatla, Petersburg, Wrangell, Yakutat, Hoonah, Nome, Bethel, Dillingham, Naknek-King Salmon, Unalakleet, Kotzebue, and Barrow. It is concluded that most parts of these towns are built on more stable geologic materials than those beneath towns heavily damaged by the 1964 Alaska earthquake. Nevertheless, in the event of a large earthquake, some communities are susceptible to damage because of an-

reports on the subsidence in Alaska region, villages, and Sagway have been released in open file, and reports are in various stages of preparation for the other communities. As of early 1973, this large project has been restructured, and report preparation responsibilities for Sitka, Metlakatla, Hoonah, Yakutat, Bethel, Naknek-King Salmon, and Unalakleet assigned to project 9550-00948.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0022, DEVELOP DESIGN CRITERIA FOR MINING SALT-DOME DEPOSITS TO MINIMIZE SURFACE SUBSIDENCE

T.A. MORGAN, U.S. Dept. of the Interior, Bureau of Mines, Denver, Colorado 80225

The objective is to evaluate the surface subsidence or surface collapse potential of multiple-level salt-dome mines and to develop engineering principles for the design of mines of this type that are safer and less prone to excessive subsidence. Subsidence is to be measured on the surface and all three mining levels. Shear strains measured on the upper levels will be related to the subsidence on those levels caused by mine closure on the lowest level.

SUPPORTED BY U.S. Dept. of Interior - Bureau of Mines

10.0023, ESTABLISH TECHNIQUES FOR MONITORING SURFACE SUBSIDENCE OVER MINED AREAS

W.J. TESCH, U.S. Dept. of the Interior, Bureau of Mines, Denver, Colorado 80225

The project objective is to monitor ground subsidence over old mined areas, using equipment operable by non-technical people and to measure ground movement over and near operating mines. Movements over old coal mined areas, operating underground coal mines, and open-pit mines will be measured. The equipment used to make these measurements will include inexpensive monitoring equipment, inclinometer probes and automatic data acquisition systems, television probes, an acoustic geologic logging system and time-domain reflectometry measurements of break cables.

SUPPORTED BY U.S. Dept. of Interior - Bureau of Mines

10.0024, MEASUREMENT AND EVALUATION OF SUBSIDENCE OVER A COAL MINE WITH VARYING OVERBURDEN THICKNESS

W.N. YOUNGS, U.S. Dept. of the Interior, Bureau of Mines, Denver, Colorado 80225

The work will include the measurement of the magnitude and rate of subsidence over several panels with different amounts of overburden and surface slopes. Measurements to be made will include vertical and horizontal movement as well as tilt.

SUPPORTED BY U.S. Dept. of Interior - Bureau of Mines

10.0025, STUDIES ON THE FLUVIAL ENVIRONMENT, ARCTIC COASTAL PLAIN PROVINCE, NORTHERN ALASKA VOLUME I

R.I. LEWELLEN, Arctic Inst. of North America, Washington, District of Columbia 20009

Abstract: The studies on the fluvial environment of the Arctic Coastal Plain, Province, Northern Alaska, include research which ranges in magnitude from small polygon troughs to the Inaru River Basin. The 208 figures include stereograms, ground and aerial photographs, graphs, curves, and maps. Ninety tables appear in the publication. The complete hydrographs for two tundra streams are included. Discussions in-

clude aerial photography, graphic entries by planimetry research. Chronologies of physical occurred in the drainage basins are listed. Photographs and reproductions of computer printouts of data are presented in the Appendices.

Pub. 1972: 308p., NTIS No. AD-749 150; PC

SUPPORTED BY U.S. Dept. of Defense - N

10.0026, RETURNING UNDERGROUND WASTES TO MINED-OUT VOIDS

R.A. CARPENTER, Natl. Acad. of Sciences, District of Columbia 20037 (C310-269-000)

The National Academy of Sciences/National Engineering will assemble a study committee to evaluate the state of knowledge and feasibility of underground coal wastes resulting from the deep mining for additional lines of investigation will be underground coal mining creates large, unsightly the surface which occupy valuable spaces, water and dust to surrounding areas. Some and occasionally slump with disastrous surface subsidence, due to collapse of underground resulted in destruction of property in many mining areas. The study findings, which will be European experiences, as well as analyses of projects in the United States, will permit judgments on allocation of research funds and legislation. The study group will have six representatives from the coal industry, State regulatory agencies, industry, and universities. Field examination will include piles and inspections made of R&D projects. Methods of replacing coal wastes in underground final report is scheduled for September, 1973.

SUPPORTED BY U.S. Natl. Science Foundation

10.0027, EARLY DETECTION AND CONTROL OF SINKHOLE PROBLEMS - ALABAMA

J.G. NEWTON, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Map existing sinkholes and areas of active sinkholes in Alabama. Investigate geologic and hydrologic conditions at sites of collapse or subsidence. Evaluate remote sensing as tools to locate potential sinkholes. Establish guidelines to detect potential sinkholes along highway corridors.

SUPPORTED BY U.S. Dept. of Transportation

10.0028, SUBSIDENCE INVESTIGATIONS OF SOILS

B.G. VOLK, Agric. Res. & Educ. Center, Beltsville, Maryland 21705 (FLA-EV-01611)

Objective: Study chemical and physical characteristics of organic soils as related to rates of soil subsidence. Investigate the effects of soil amendments such as sand, clay, gypsum, and organic fertilizers and sludge materials as possible in reducing subsidence. Investigate compounds found in the decomposition chain of organic soils in the Everglades and other areas.

Approach: Soil analysis - complete chemical and physical characteristics. Effects of environmental and agricultural practices on subsidence. Carbon dioxide evolution and soil moisture content will be determined and used as a basis for soil subsidence. Variables considered will include

temperature, time of incubation, soil pH, and water table height. Effects of soil treatments on subsidence. Amendments such as sand, clays, aluminum compounds, soil sterilizers, pesticides, and sludge materials will be added to histosols to check subsidence inhibiting. Identification of compounds in organic soil decomposition. Chemical changes occurring as the organic matter decomposes will be followed by analysis of various fractions for functional groups and basic chemical structures.

Progress. The purpose of this investigation is to study the chemical and physical characteristics of histosols as related to rates of soil subsidence. Using chemical and spectroscopic methods, higher subsidence rates can be associated with the following changes in humic acid chemistry: (2) increases in CO(2)H , phenolic OH, quinone, and ketonic CO groups; (b) decreases in aliphatic structures as shown by IR spectra and aliphatic OH groups, and (c) decreases in molecular complexity as indicated by H(4)/H(6) ratios. The chemical reactions involved appear to be mainly oxidative, leading at first to the degradation of aliphatic structures and finally attacking the most stable aromatic structures with degradation to CO(2) . CO(2) evolution determinations from soil columns by an automated continuous flow infrared gas analyzer show that increasing temperatures and water table depth are directly related to increased subsidence. Montverde muck, a Typic Mellichist, lost 3.15 cm/yr as evolved C whereas Terra Ceia muck, a Typic Medisaprist, lost 1.61 cm/yr. Bulk density and % ash were inversely related to the C loss.

SUPPORTED BY Florida State Government - Tallahassee

10.0029, REMOTE SENSING, ALFAHA AND PEACE RIVER BASINS, FLORIDA

A.E. COKER, U.S. Dept. of the Interior, Geological Survey, Tampa, Florida

(1) Fluorides and phosphates in central Florida move into the local environment by seepage from cattlen lagoons designed to contain acid effluents produced from processing of phosphate ore. A marked need exists to rapidly detect and monitor areas subjected to these contaminants. (2) A decline of hydrostatic pressure has accelerated the natural process of sinkhole formation and homes and roads are subjected to sudden collapse. Subsurface geologic features such as relic sinkholes, and faults are related to areas of impending collapse. A marked need exists to refine the techniques for detecting areas of potential land collapse by remote sensing techniques.

(1) To synoptically and regionally detect areas subjected to high concentrations of fluorides and phosphates and develop techniques to rapidly monitor extensive land areas subjected to these contaminants. (2) To detect hydrogeologic conditions related to areas of impending land collapse and develop the techniques for delineating land areas which have a low probability for collapse and/or subsidence. In addition, these techniques may be used to delineate areas where artificial recharge, irrigation and drainage practices may be defined and effectively applied.

To apply remote sensing techniques to the detection and monitoring of fluoride and phosphate contamination and the delineation of hydrogeologic conditions and geologic structures related to impending land collapse. (1) Ground-truth test sites are established to test airborne remote sensing data for the specific experiments. (2) Remote sensing spectral

Multispectral parameter mapping techniques to detect phosphate contaminated areas by remote sensing developed. Fluoride-phosphate contaminated areas detected by utilizing airborne ultraviolet scanner, digitally density processed.

SUPPORTED BY U.S. Dept. of Interior - Geology

10.0030, VERIFICATION OF EMPIRICAL METHODS FOR DETERMINING RIVERBANK STABILITY (PHASE I) INVESTIGATIONS - SOILS PHASE)

C.C. CALHOUN, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Purpose of study/investigation: To determine causes of riverbank failures along the lower Mississippi river and to develop criteria for predicting soil conditions and susceptibility to liquefaction-type failures.

Approach or plan: Boring logs and gradation data planned for revetment in the Memphis, Vicksburg, and New Orleans Districts are analyzed and potential susceptibility to liquefaction is predicted. Field surveys of riverbank failures furnished by the three districts are evaluated to determine type of failure (either shear or liquefaction or slide), and previous predictions based on empirical criteria are evaluated.

Progress to date: Annual reports were published from 1954 to 1968. Starting with the 1968 data, reports are published biennial. The first biennial report, Potomacology Report 12-21, Verification of Empirical Methods for Determining Riverbank Stability, 1968 and 1969 Data, was published. The empirical criteria, modified in 1968, are used to classify fine sands into zone A and zone B, to predict gradation, and to predict potential susceptibility to liquefaction if the zone A sand thickness is 20 ft. or more, or the ratio of overburden thickness to zone A sand thickness is 0.85 or less. During 1968, the criteria were expanded to include the depth of thalweg for making predictions in the New Orleans District. Since 1954, a total of 10 flow failures have been recorded within 500 ft. of boring locations, with 91 locations predicted to be stable and only 12 locations predicted to be unstable. In many locations predicted to be unstable, no flow failures have been experienced.

SUPPORTED BY U.S. Dept. of Defense - Army

10.0031, MEASURE AND PICTURE TROUBLE SPOTS - STEREO MODELS - OHIO

W.F. NORELL, State Dept. of Transportation, Columbus, Ohio 43215

Stereo photo keys are being developed for stereoplotters in detecting and mapping foundation problem areas: landslides, landform changes, to mining, soft foundations, sinkhole topography, and deposits. Reports issued: 'Air Photo Patterns of Landslides in Southeastern Ohio', W.F. Norell, January 1966. 'Crop and Overburden Mapping with Kelsh Plotter', W.F. Norell, Highway Research Record No. 109. 'Air Photo Patterns of Subsurface Mining in Ohio', W.F. Norell, January 1968. 'Ohio Photogrammetric Research Solves Foundation and Right of Way Problems', Digest of Interim Report of Research by Wayland F. Norell, Ohio State Roads, Vol. 36, No. 9, August 1971.

SUPPORTED BY U.S. Dept. of Transportation - Ohio

10-0032, The objective of this proposal is to develop a technique which, when incorporated in groundwater management programs, will permit an optimum utilization of water resources, consonant with acceptable minimal subsidence. Specifically, the proposed technique will assist in the determination of the areal distribution of water wells, and in the selection of aquifer intervals to be exploited and the tolerable rates of depletion. The application of the technique will minimize and possibly halt subsidence where it is objectionable, thereby reducing damages being incurred by urban systems.

The proposed technique will be developed by correlating data obtained from several U.S. Geological Survey observation and test wells, located in the Houston-Galveston area, with laboratory consolidation characteristics of clay samples taken from the aquifer systems underlying the subsidence field under investigation. The laboratory equipment will simulate field conditions. The clay specimens will be subjected to the effect of slow fluid pressure decline. A computer program will be developed to facilitate the calculation of the anticipated amount and rate of land subsidence associated with a given rate of fluid pressure decline over a given area.

SUPPORTED BY U.S. Natl. Science Foundation

10.0033, DEMONSTRATION OF A TECHNIQUE FOR LIMITING THE SUBSIDENCE OF LAND OVER ABANDONED MINES ROCK SPRINGS, WYOMING

UNKNOWN, Unknown Inst. or Indiv. Grant, Wyoming

This report provides guidance to community planners and decision-makers facing subsidence problems over abandoned mines. It is based upon the findings, results, and conclusions of the demonstration project carried out by the City of Rock Springs, Wyoming in October 1970. The aims of the project were: Demonstrate the feasibility of backfilling underground mine voids for the prevention and alleviation of surface subsidence by a process developed by Dowell, a division of Dow Chemical Company. Assess the relative effectiveness of the process, its cost and benefits and its potential utility in other applications. Determine how the process might be applied in other cities like Rock Springs to deal with their subsidence problems. Determine whether the process advances the technology for subsidence prevention.

Pub. Nov. 73: 28p., NTIS No. PB 212708, PC \$3.00.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

11. SNOWSTORMS

DISASTER MITIGATION

11.0001, URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, loss of

problem, as well as costs and effectiveness of reduction measures, and agencies responsible for measures.

Pub. Jun 73: 111p., NTIS No. PB-222 447/5: PC \$1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

11.0002, SNOW AND ICE DETECTION AND SYSTEMS

A.I. MCCONE, M.B. Associates, San Ramon, Calif. (045294)(TRAIS)

The objectives of this contract are to determine systems for snow and ice detectors, to select the best available for each requirement, and to evaluate a warning system for icy bridge conditions. Work includes a reference manual for use by maintenance and engineers in selecting, installing, operating and maintaining or multiple snow and ice detection and warning systems.

Document provided to S.S.I.F. by the T.R.A.I.S.

SUPPORTED BY U.S. Dept. of Transportation

11.0003, THE MODIFICATION OF GREAT LAKES WINTER STORMS

H.K. WEICKMANN, U.S. Dept. of Commerce, Natl. Phys. & Chem. Lab., Boulder, Colorado 80302

Abstract: In the Great Lakes region of the U.S.A., intensive winter storms form through a combination of continental air moving over large still-unfrozen warm water surfaces. These storms, depending on trajectories over the lakes and their persistence, precipitate large amounts of snow onto the shorelines of the Great Lakes. Natural freezing concentration causes heavily rimed crystals to form; increases their number, and prevents riming, which causes smaller crystal fall velocities. Consequently smaller velocities mean a longer transport of snow and away from the urban and industrial centers of the shores. The experiment is designed around a numerical model and a microphysical model of snow formation. The great variability of the cloud systems requires a clear definition of a homogeneous sample of experiments and, therefore, makes a clear statistical analysis possible. The execution involves seeding from the air, tracking the seeding agent through the cloud, an airborne freezing nucleus counter, and analysis of nuclei in the precipitated snowcrystals.

Pub. Jan. 73: 113p., NTIS No. COM. 73-50830/1: PC \$1.45- NTIS.

SUPPORTED BY U.S. Dept. of Commerce - N.O.

11.0004, NATIONAL EAST COAST WINTER STORMS OPERATIONS PLAN

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmospheric Admin., Rockville, Maryland 20852

Abstract: The report discusses the National East Coast Winter Storms Operations Plan to develop a program to furnish weather observations for use in predicting adequate and timely warnings of severe winter storms along the east coast of the United States. The plan considers the use of surface platforms, satellites. Arrangements, if practical, are made to coordinate the use of surface platforms, satellites, and other resources for the purpose of obtaining weather observations for use in predicting adequate and timely warnings of severe winter storms along the east coast of the United States.

11.0005, SNOW FORECASTING FOR SOUTHEASTERN WISCONSIN

R.W. HARMS, U.S. Dept. of Commerce, Natl. Weather Service, Kansas City, Missouri

Abstract: There are several types of winter storms which can produce very heavy snow in southeastern Wisconsin and the lower Great Lakes region. Two of these appear to be readily recognizable in their early stages of development. To facilitate discussion by forecasters these have been designated by the popular names, 'Painhandle Hook' and 'Alberta Clipper'. A third type, the 'Lower Mississippi' storm, is more erratic and considerably more difficult to forecast, as are the 'Westerly Storms' which travel south of Wisconsin and generally begin with snow but usually change to freezing rain and then rain or drizzle. This paper presents a model for each of these types of storms, and a snow depth forecasting scheme with modifications for types where appropriate.

Pub. Nov. 70: 22p., NTIS No. COM-71-00119: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

11.0006, A SYNOPTIC CLIMATOLOGY FOR SNOWSTORMS IN NORTHWESTERN NEVADA

B.L. NELSON, U.S. Dept. of Commerce, Natl. Weather Service, Salt Lake City, Utah

Abstract: The purpose of this study is to provide a climatological aid for forecasting snow in northwestern Nevada. A total of 112 snowstorms affecting Reno, Lovelock, or Winnemucca were analyzed to determine if these storms could be categorized into separate types. Five separate categories were defined and are discussed. Examples of four of these types are provided. A separate discussion of the unusual thunderstorm-snowstorm occurrence on May 20 - 21, 1971, is also provided.

Pub. Feb. 72: 30p., NTIS No. COM-72-10338: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

11.0007, PHYSICAL EVALUATION OF CLOUD SEEDING TECHNIQUES FOR MODIFYING OROGRAPHIC SNOW-FALL - THE CASCADE PROJECT

P.V. HOBBS, Univ. of Washington, School of Arts, Seattle, Washington 98105

In 1968, the University of Washington, under support from the Department of Interior and the State of Washington, initiated the 'Cascade Project' which was designed to develop a seeding technique for redistributing snowpack from winter storms from the west slope of the Cascade Mountains to the east slope in order to augment the Spring runoff into the Skagit River and Baker River which service the mid central region of the State of Washington. Criteria have been established for snowpack redistribution and in FY 1974, the University of Washington will establish the design for a possible pilot operation under joint State and Federal funding. This grant will provide support to the University of Washington to supplement the present statistical design with scientific observations, and mathematical model development which will assist in the understanding of the atmospheric mechanisms involved in snowpack redistribution, and permit the transfer of this technology to other geographical areas.

SUPPORTED BY U.S. Natl. Science Foundation

The purpose of this project is to perform all empirical and theoretical analyses necessary for a complete treatise on the control of blowing and drifting snow, based on the experience of the investigator, published literature, and studies of the Wyoming I-80 Snow Fence System. Specific items to be included are estimation of required capacity, optimum configuration, height, and placement of snow fences; tripping efficiency; procedures in engineering; and highway design for minimizing snow problems.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY Wyoming State Government - Cheyenne

HAZARD REDUCTION**11.0009, FREQUENCY AND INTENSITY OF FREEZING RAIN/DRIZZLE IN OHIO**

M.E. MILLER, U.S. Dept. of Commerce, Weather Bureau, Garden City, New York 11530

Abstract: Information presented in the study could be used to determine the probable stress which buildings, utility lines or other subjects would have to withstand from ice storms in Ohio. A mean recurrence table of annual number of days with freezing rain/drizzle for return periods of 2, 5, 10, 25, 50, and 100 years was devised for eight Ohio locations from output generated from a Poisson probability routine. Daily precipitation amounts associated with Ohio ice storms were less than .06 inch on 72.6 to 89.6% of the days with freezing rain/drizzle. Wind direction and speeds associated with periods of freezing rain/drizzle were also summarized.

Pub. Feb. 73: 11p., NTIS No. COM-73-10570: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12. TORNADOES**INDIVIDUAL ASSISTANCE****12.0001, DISASTER INVESTIGATIONS**

C.G. CULVER, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234

Reasons for starting or progress last year: Post disaster investigations conducted last year include: (1) Flood damage following Hurricane Agnes, (2) Managua Earthquake investigation, (3) Collapse of Skyline Towers high-rise apartment building, and (4) Tornado damage in Fairfax County, April 1973.

The Hurricane Agnes investigation led to an NBS project for the Department of Housing and Urban Development in which NBS supplied technical assistance to HUD relative to the temporary housing (mobile homes) provided to the flood victims. A final report on the project was submitted to HUD on December 13, 1973. During the Managua Earthquake investigation, the CBT post disaster survey team provided direct assistance through the U.S. State Department to the Nicaraguan government in evaluating the safety of damaged buildings in Managua. A report of this work will be published in the Bulletin of the Seismological Society of America. In addition, CBT is working through the Department of Commerce in assisting with the development of building standards

12.0002.

had been violated during the construction of the building and if standards violation contributed to the collapse. A final report on this project was submitted to OSHA on June 11, 1973. In addition, an Interagency Agreement between NBS and the Department of Labor related to continuing NBS technical assistance relative to OSHA activities was formalized.

The investigation of tornado damage provided direct input to a project being conducted by CBT for the Defense Civil Preparedness Agency regarding the natural hazards evaluation of existing buildings. Typical failure modes produced by tornadoes were identified and significant building parameters to be evaluated in surveying the hazard potential of existing buildings were developed.

Approach: Investigations will be conducted following the occurrence of significant natural disasters including earthquakes, hurricanes and tornadoes. Surveys of other disasters, such as building collapses, fires, etc. will also be conducted as part of this program. (Text Abridged)

SUPPORTED BY U.S. Dept. of Commerce • N.B.S.

12.0002. TORNADO - THE VOICE OF THE PEOPLE IN
DISASTER AND AFTER - A STUDY IN RESIDENTIAL
INTEGRATION - TEXAS. (LUBBOCK?)

M.S. MINNIS, Texas Technological University, School of Arts,
Lubbock, Texas 79409

Abstract: The basic focus of this research design is the study of the adjustment of the three ethnic groups, Anglo, Negro, and Mexican American—reflecting the tri-partite population composition of the city—to their new neighbors and their new residential setting. How do people learn to live together when they must—not directed by law or human value systems but by the freakish circumstance of nature, a destructive tornado.

Pub Sep. 71: 197p., NTIS order No. PB-205 752: PC \$3.00
MF \$0.95.

SUPPORTED BY Texas Technological University - Lubbock

PUBLIC ASSISTANCE

12.0003, THE OCHEL TREE TORNADO - A CASE STUDY - MISSOURI

W.E. FINLEY, U.S. Air Force, Environ. Tech. Appl. Center,
Washington, District of Columbia

Abstract: A classic example of the midwestern United States tornado occurred near Richards-Gebaur AFB, Missouri, on 1 May 1972 (GMT date) as an associated feature of a steady-state severe thunderstorm. This case study of that storm describes synoptic and mesoscale aspects of the situation using meteorological charts and diagrams and presents radar scope photographs from the Air Force Air Weather Service AN/FPS-77 Storm Detection Radar at Richards-Gebaur AFB, near Kansas City, Missouri. Included in the photographs are several highly unusual range height indicator (RHI) sections through the parent thunderstorm and tornado tube. A partial survey of damage caused by the tornado is included. Some suggestions to non-centralized weather forecasters for coping with an imminent tornadic thunderstorm are presented in the final section of the Technical Note.

Pub. Mar 73: 35p., NTIS No. AD-768 391/5; PC \$3.00 MF \$1.45.

UPPORTED BY U.S. Dept. of Defense - Air Force

Abstract: The Building Research Division of the Federal Bureau of Standards Institute of Applied Technology has assembled a three-man team to investigate the damage to other structures caused by the tornado which struck Dallas, Texas, on May 11, 1970. The authors of this report carried out part of the investigation on the ground and from a helicopter on May 12, 13, 14, 15, and 16, 1970. The report is based on the data collected during this period but includes some information from other agencies and individuals whose assistance was obtained in the report. The report concludes that the use of wind tunnel tests in the design and construction of buildings would have greatly reduced the damage to the buildings in the Dallas area. It also notes that natural disasters are a major cause of damage to buildings and urges the development of criteria with respect to wind loads for buildings.

Pub. Mar 71; 44p., NTIS No. Com.
\$0.95-NTIS.

SUPPORTED BY U.S. Dept. of Commerce

12.0005, FEDERAL PLAN FOR ME
VICES & SUPPORTING RESEAR
1974

UNKNOWN, U.S. Dept. of Commerce
mos. Admin., Washington, District of

Abstract: The federal plan is the ninth developed by the federal coordination services and supporting research in response to Public Law 87-843. This plan focuses on terrorist services that will contribute to the safety and welfare and to the effectiveness. The highest priority is being given to observe, predict, and prevent storms, such as hurricanes and tornadoes.

Pub. Jun. 73: 62p., NTIS No. COM-74
\$1.45.

SUPPORTED BY U.S. Dept. of Commerce

12.0006. XENIA REBUILDS

UNKNOWN, Xenia Commission, Xenia

This report contains strategies for relief after a disaster. It is concerned with the factors that affect reconstruction, objectives and policies for reconstruction, existing situation, design concepts for reconstruction, institutional situation, land use recommendations, and implementation mechanisms. It also discusses the manner in which an economically sound reconstruction can be carried out in a form which is both acceptable and sustainable.

SUPPORTED BY U.S. Dept. of Home
ment

12.0007, MORPHOLOGY OF TWO
AN ANALYSIS OF NSSI DATA
OKLAHOMA CITY, OKLAHOMA

S. L. BARNES, U.S. Dept. of Commer.
Lab., Norman, Oklahoma

Abstract: On the night of April 29-30, 1980, thunderstorms passed over the NSSI-operated network in central Oklahoma. More than 100 graphic recordings, upper air soundings, and digital radar data were collected. This is part of a series concerning various

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0008, TORNADO INCIDENCE MAPS

A. COURT, U.S. Dept. of Commerce, Natl. Severe Storms Lab., Norman, Oklahoma

Abstract: Tornado occurrences in the United States have been tabulated and shown on maps since 1884, but very few of the 109 such maps, reproduced and discussed here, show actual tornado incidence per year per unit area; most are totals for periods of 6 to 62 years, by states, or by latitude-longitude quadrangles of varying areas. In the past century, the apparent center of maximum tornado incidence has moved southwestward, from western Illinois to Iowa and Missouri, to Kansas, and now to Central Oklahoma, where the annual incidence per 10,000 square miles is 3 to 21 tornadoes, depending on the period for which reports are used. Proliferation of official tabulations, by states and quadrangles and for varying periods, has obfuscated the pattern of tornado occurrence, and failure to tabulate and map the actual damage areas has precluded a clear depiction of actual tornado hazard. To eliminate confusion, tabulations and damage area maps by 5-year and 10-year periods beginning in 1956 are recommended.

Pub. Aug. 70: 84p., NTIS Order No. COM-71-00019; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0009, TORNADOES IN TENNESSEE (1916-1970) WITH REFERENCE TO NOTABLE TORNADO DISASTER IN THE UNITED STATES (1880-1970)

J.P. CAKSNORAN, U.S. Dept. of Commerce, Natl. Weather Service, Nashville, Tennessee

Abstract: The growing need for tornado information on time and areal distribution prompted this study. A description of most destructive past tornadoes in Tennessee is given. Charts and tables of statistics of tornado occurrence, days, death, injuries and damage are presented. A remarkable improvement in the tornado fatality rate in recent years is noted.

Pub. Dec. 71: 37, NTIS No. COM-72-10349; PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0010, ARIZONA 'EDDY' TORNADOES

R.S. INGRAM, U.S. Dept. of Commerce, Natl. Weather Service, Salt Lake City, Utah

Abstract: Not all tornadoes and funnel clouds reported in Arizona are true tornadoes. Perhaps as many as 75 percent of them are 'eddy tornadoes', dust devils, hail shafts, or areas of heavy rain. The apparent increase from 1963 to 1973 is not believed to be related to changing meteorological conditions, but to other factors such as: increase in population; increase in public awareness due to disaster publicity; overreaction due to the 1971 tornado in Tempe; and the fact that not all localized circular storms are true tornadoes.

Pub. Oct. 73: 13p., NTIS No. COM-74-10465/4; PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

DISASTER MITIGATION

12.0011, URBAN GEOLOGY PLAN FOR CALIFORNIA -

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, loss of mineral resources to urbanization, landsliding, flooding, erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of possible loss-reduction measures, and agencies responsible for those measures.

Pub. Jan. 73: 111p., NTIS No. PB-222 447/5; PC \$7.75 MF \$1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

12.0012, NATIONAL SEVERE LOCAL STORMS OPERATIONS PLAN

R.E. HALLIGREN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

Abstract: This is the sixth of an annual series of National Severe Local Storms Operations Plans. It outlines the responsibilities of the various United States agencies which provide meteorological services in observing and forecasting severe local storms. One chapter provides definitions and other chapters deal with details on forecasts and warnings, communications, observation and publicity. Includes maps showing county warning areas by regions; lists of radar sites and weather stations; and a table showing non-network upper air stations which might be sources of data.

Pub. Jan. 73: 57p., NTIS No. COM-73-10510; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0013, NATIONAL EAST COAST WINTER STORMS OPERATIONS PLAN

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

In a memorandum dated October 23, 1969, the Chairman, Interdepartmental Committee for Meteorological Services (ICMS), established an Ad Hoc Group to function under the purview of the Subcommittee on Basic Meteorological Services (SC/BMS). The task of the Group was to develop an Operations Plan designed to furnish weather observations for use in predicting and providing adequate and timely warnings of severe and crippling winter storms along the east coast of the United States. This Plan was to consider use of surface platforms, aircraft, and satellites. Arrangements, if practical, were to be made to meet the data requirements of research facilities.

The National East Coast Winter Storms Operations Plan was developed to meet this request.

The following revised Plan has been developed to reflect the current systems and procedures.

Pub. Oct. 73: 103p., FCM 73-7, U.S. Dept. of Comm., NOAA. Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0014, NATIONAL SEVERE LOCAL STORMS OPERATIONS PLAN - 1974

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

sibilities of the various United States agencies which provide meteorological services in observing and forecasting severe local storms.

Interdepartmental Severe Local Storm Conferences, of which there have been four, bring together cognizant Federal agencies to resolve problems of mutual concern related to the National Severe Local Storms Warning Service. Such conferences are now held biennially. National Weather Service Severe Local Storm Conferences are held annually.

This plan supersedes the 1972 interdepartmental version and reflects the recommendations of the 1973 National Weather Service Severe Local Storms Conference and the SC/BMS Working Group on Severe Local Storms.

Pub. Feb. 74: 53p., FCM 74-3, U.S. Dept. of Comm., NOAA.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0015, MISSISSIPPI DELTA TORNADOES OF FEBRUARY 21, 1971 - A REPORT TO THE ADMINISTRATOR

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

The morning after the disastrous tornadoes swept through northwest Louisiana, northwest Mississippi, and southwest Tennessee, a survey team was dispatched by the National Oceanic and Atmospheric Administration to the devastated areas to review the effectiveness of NOAA's tornado warning services. This report, Mississippi Delta Tornadoes of February 21, 1971, presents the findings and recommendations of the survey team.

Pub. Jul. 71: 57p., Natural Disaster Survey Report 71-2, U.S. Dept. of Comm., NOAA.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0016, WATER WARNINGS AND SPECIALIZED FORECASTS

UNKNOWN, U.S. Air Force, Air Weather Service, Belleville, Illinois 62225

Abstract: The manual states policy, outlines responsibilities, and prescribes procedures for providing weather warnings and specialized forecast support to authorized recipients. AWS/DO is OPR for Volume I, which applies to all AWS units. AWS Forms 39 and 39a are prescribed in this volume.

Pub. Oct. 71: 28p., NTIS No. AD-732 263: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0017, DENSE RAIN GAGE NETWORK PROJECTS - II. ILLINOIS

S.A. CHANGNON, State Water Survey, Urbana, Illinois 61801

A long-term project in which two dense rain gage networks encompassing 800 and 2200 square miles are presently operated to provide basic data for various climatological, hydrometeorological, and severe storm studies. Data also provide useful information for evaluating the potential of weather modification and designing precipitation modification experiments. One network is located in the St. Louis area to study urban-industrial effects on rainfall and the other in the central Illinois flatlands to sample different climatic and rural conditions.

SUPPORTED BY Illinois State Government - Springfield

Abstract: The aspects of wind-induced building motion resulting human response are investigated. A criterion and rational approach for considering this in building design are proposed. The physical character of wind-induced building acceleration motion is described. Methods for estimating acceleration are considered. A simplified analytical approach in equation and design code is presented. The general problem of human response to building motion is discussed and the results of response surveys conducted in two tall buildings affected by wind storms are reported.

Pub. Nov. 71: 261p., NTIS No. PB-205 262: PC \$10.95.

SUPPORTED BY U.S. Natl. Science Foundation

12.0019, NUMERICAL ANALYSIS OF TORNADO LOADS ON BUILDINGS - TEXAS

R.A. GENTRY, U.S. Atomic Energy Commission, Los Alamos Scientific Lab., Los Alamos, New Mexico 45202

A detailed numerical study of the various flow variables meteorological data will be conducted on the May 1, 1969 Lubbock tornado. The following tasks will be performed: 1) A reconstruction of local wind conditions in the vicinity of each major structure studied; 2) Graph representation of computed wind and pressure fields in the vicinity of buildings studied; 3) Pressure contour plots depicting estimated wind pressures on major building surfaces; 4) Analysis of the relationship between the computed wind pressures and the estimated loads from structural damage studies.

SUPPORTED BY U.S. Natl. Science Foundation

12.0020, SUMMARY OF 1969 AND 1970 PUBLIC THUNDERSTORM AND TORNADO WATCHES ISSUED BY THE NATIONAL WEATHER SERVICE, EASTERN REGION

M.E. MILLER, U.S. Dept. of Commerce, Weather Bureau, Garden City, New York 11530

Abstract: The purpose of this report is to summarize, for responsibility, the severe local storm watches issued by the Eastern Region, during 1969 and 1970. Only those watches which affected the assigned area of responsibility in making each station's tabulation. Watches outside the assigned area, but within 100 miles, were not included in station tabulations. For this two year period, eight Eastern Region stations with the greatest number of watches within their assigned areas of responsibility were selected. In Ohio, in 1970 there were nearly twice as many public thunderstorm and/or tornado watches within the Northern Region as compared to 1969. Nearly 45% of local storm watches during 1969 and 1970 had durations of 1300 to 1600 EST.

Pub. Oct. 73: 32p., NTIS No. COM-74-10160/1: PC \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0021, TORNADOES

E. KESSLER, U.S. Dept. of Commerce, Natl. Severe Storm Lab., Norman, Oklahoma

Abstract: The prominent characteristics of tornadoes from a sociological and meteorological importance, aspects of the National Weather Service that pertain to storm detection and warning, and observational and theoretical studies of tornadoes.

Case histories of two severe thunderstorm situations in Oklahoma illustrate how the WSR-57 contour display aids identification of severe local storms. The path leading from analysis of the radar display and other data to dissemination of severe storm advisories is examined. Results indicate present and potential roles of various information sources in the weather warning system.

Pub. Apr. 73: 19p., NOAA Tech. Memo ERL NSSL-63, NTIS.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

HAZARD REDUCTION

12.0023, SEVERE STORM MORPHOLOGY - OKLAHOMA

S.L. BARNES, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302

Research/service objective: Determine the meteorological conditions in and around severe thunderstorms as an aid in developing morphological and dynamical concepts regarding their internal nature and their dependency on and interaction with the ambient atmosphere.

Research/service plan: Completion of ongoing case studies which combine surface and upper air measurements with conventional and single Doppler radar information should reveal additional structural details of severe thunderstorms not heretofore observed. Detailed observation of tornado cyclones is expected to cast new light on the conditions required for their formation and how, once established, they interact in environmental flow. Single Doppler data obtained in a tornado-producing storm (Union City, Oklahoma, May 24, 1973) will be correlated with surface wind and pressure measurements from a dense network of stations and a small sample of upper air soundings to provide a comprehensive description of such storms. This portion of the project's work will be closely coordinated with other NSSL projects studying individual aspects of this storm. Also in concert with other laboratory projects, plans for an expanded observational program centered about dual Doppler data acquisition will be developed for the Spring of 1974. Several new technological developments will be addressed including objective analysis of Doppler velocity measurements in three-dimensional space and computer abstracting of surface strip records.

Progress report: A technique for analyzing the distribution of meteorological variables by computer was applied to routinely-available weather reports from Oklahoma and adjacent states to provide operational guidance information for predicting severe storm outbreaks. A variety of computer/plotter techniques were developed to more rapidly and accurately display important meteorological parameters such as streamlines and isotaehs. A preliminary report on the structure of two tornadic storms was presented at the 15th Radar Meteorology Conference. The evolution of a storm that produced twin tornadoes revealed the important role of the thunderstorm gust front in the tornado genesis mechanism.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0024, PAPERS ON OKLAHOMA THUNDERSTORMS, APRIL 29-30, 1970

S.L. BARNES, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302

30, 1970. Calculations based on three-hourly wind reveal that strong surface moisture convergence characterized the development region throughout the Severe Storms Laboratory rawinsondes, taken over a 1-hour period when storm intensities increased, indicating low-level moisture, intruding dry air at mid-levels, increasing winds aloft. Magnitudes of Lifted Index, height of wet-bulb zero and hail size close to the defining studies' results for severe thunderstorms in these four thermodynamically-based parameters commonly used to estimate storm intensity, particularly changes in storm severity.

Pub. May 74: 233p., NOAA Tech. Memo. ERL NSSL-63, NTIS.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0025, LIFE CYCLE OF FLORIDA KEY WATERSPOUTS

J.H. GOLDEN, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302

Analyses show that waterspouts have a characteristic life cycle consisting of five overlapping stages: (1) the initial stage, identified by a prominent light-colored disc of cloud base, surrounded by a dark patch diffuse on the surface that is a manifestation of a complete vortex; (2) the spiral stage, characterized by development of alternating dark and light surface bands spiralling around the dark spot; (3) the ring (incipient spray vortex), concentrated around a dark spot, with a lengthening funnel above; (4) the spout (spray vortex), determined as the stage of maximum overall organization and intensity; and (5) the dissipating stage, characterized by waterspout dissipation (often abrupt) forced by cool downdrafts from a nearby rainshower.

Frequent waterspout formation in the Florida Keys is a life cycle apparently result from transfer of angular momentum among five scales of atmospheric motion: (1) the funnel scale, corresponding to the waterspout with funnel diameters from 10 to 500 ft; (2) the surface scale, from 500 to 3,000 ft at the surface; (3) the intermediate scale, from less than 1 to 5 mi; (4) the cloudline scale, from 5 to 100 mi; and (5) the synoptic scale, several hundred miles. The differing roles of the various scales of motion are assessed.

Pub. Jun. 74: 147p., NOAA Tech. Memo. ERL NSSL-63, NTIS.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0026, DOPPLER RADAR METHOD FOR OBSERVATION OF CONVECTIVE STORMS

R.M. LHERMITTE, U.S. Dept. of Commerce, Nat. Severe Storms Lab., Boulder, Colorado 80302

Abstract: The authors outline the concept involved in the design parameters required for optimizing the use of the dual-Doppler method. The accuracy of two-dimensional velocity estimates, as controlled by radar signal-to-noise and data processing, and the method required to achieve this accuracy are also discussed.

Pub. 1972: 7p., NTIS No. COM-73-10119-40.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0027, EM RADIATION-TORNADOES

JV TAYLOR, U.S. Dept of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302 (2C371242)

Research/service objective Study EM radiation from the lightning associated with severe storms to determine electrical characteristics that indicate the spawning or existence of tornadoes

Research/service plan Analyze previously collected data to determine EM characteristics of tornadoes and continue to record and analyze data from the 15 tornado detectors operating in "Tornado Alley" through September '73, improve detectors by adding direction finding capability, and continue operational tests in calendar 1974.

Progress report Burst rates obtained from observations at frequencies above 1 MHz are most indicative of tornado and severe storm activity. Very good preliminary correlations between burst rates from the 3 MHz detectors and severe storm reports have been obtained.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0028, HURRICANE SPAWNED TORNADOES

D.J. NOVLAN, Colorado State University, School of Engineering, Fort Collins, Colorado 80521

Abstract An updated climatology of hurricane tornadoes is presented from information gathered for U.S. cases from 1948-72 and typhoon induced tornadoes over Japan from 1950-71. The paper presents a qualitative tornado genesis model which attempts to demonstrate the crucial importance of large low level vertical wind shear in the genesis mechanism. A forecasting guide is also given. The most important difference between storms which produce tornadoes and those which do not is a very large increase of the vertical shear of the horizontal wind between the surface and 4-5 thousand feet. This averages about 40 knots for the tornado cases, but is much less in the cases which do not produce tornadoes.

Pub. May 73: 64p., NTIS No. COM-73-11296/3. PC \$5.00 MF \$1.45

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0029, FORECASTING GUSTY SURFACE WINDS IN THE CONTINENTAL UNITED STATES

A.W. WATERS, U.S. Air Force, Air Weather Service, Belleville, Illinois 62225

Abstract: The technical report contains case studies of strong surface wind gust occurrences which occur under specific conditions in certain designated areas called "Wind Boxes." There are ten such wind boxes within the contiguous United States. Actual cases are included with several of the main weather charts used in forecasting gust occurrences. Procedures shown herein are a relevant part of the method used by the Military Weather Warning Center in forecasting gusty surface winds.

Pub. Jan 70: 76p., NTIS No. AD-706 392. HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Defense - Air Force

12.0030, ESTIMATE OF MAXIMUM WIND SPEEDS OF TORNADOES IN THREE NORTHWESTERN STATES - IDAHO, OREGON, WASHINGTON

T.T. FUJITA, Univ. of Chicago, School of Physical Sciences, Chicago, Illinois 60637

Each storm was reevaluated using the author's "tornado characterization" based upon the intensity of each storm. Combined analyses of the data characterized tornadoes and hailstorms revealed the existence of tornado alleys and hail swaths in the area. It was concluded that the maximum speed of tornadoes ranges between 200 and 225 mph and minimum wind speed of 175 mph seems to be a figure for tornadoes elsewhere. Expected maximum pressure drop of 1.5 psi and time change of 1 sec in pressure of 200-mph tornadoes were also

Pub. Dec 70: 34p., NTIS No. COM-71-00731. PC \$0.95

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0031, PROPOSED CHARACTERIZATION OF TORNADOES AND HURRICANES BY AREA AND INTENSITY

F.T. FUJITA, Univ. of Chicago, School of Physical Sciences, Chicago, Illinois 60637

Abstract: The research paper provides data in support of a proposed characterization of tornadoes and hurricanes by area and intensity. A test characterization of 1950-69 tornadoes in 1950-69 was accomplished for 893 U.S.A. tornadoes in 1965. The percentage distribution of intensity and individual area of U.S. and Japanese tornadoes is very similar except for large and/or intense tornadoes. It was found that the F-scale variation along the paths of tornadoes showed an intensity oscillation with a 45% variation. Characterization of hurricanes and typhoons showed that average typhoons are more intense than average hurricanes.

Pub. Feb 71: 53p., NTIS No. COM-72-10828. PC \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0032, STUDY OF URBAN EFFECTS ON PRECIPITATION AND SEVERE WEATHER AT ST. LOUIS, ILLINOIS

S.A. CHANGNON, State Water Survey, Urbana, Illinois 61801

Abstract: The activities and results reported upon in this project represent those resulting from the second year of a project. The general goal of the Water Survey project involving METROMEX (Metropolitan Meteorological Experiment) consists of the delineation of any anomalous precipitation and severe weather patterns and from St. Louis and environs, the quantification of the frequency of such anomalies, investigations of the relevance of findings to the local area and to other urban areas of Illinois, and the transmission of these findings to potential users in the scientific community and to the public. New activities largely concerned (1) a decrease in instruments to define better precipitation patterns; (2) instrumentation was added to better define temperature and humidity patterns of the surface; (3) field observations and analysis pertaining to the airflow and urban circulation; (4) the external application for transmission of findings to users.

Pub. Apr 73: 54p., NTIS No. PB-230 325/3. PC \$1.45.

SUPPORTED BY U.S. Natl. Science Foundation

12.0033, HYDROMETEOROLOGICAL ANALYSIS

analyses are based on radar, synoptic weather, and field survey data, and include area-depth-duration relations, antecedent rainfall evaluation, isohetal maps for peak periods of storm.

SUPPORTED BY Illinois State Government - Springfield

12.0034, STUDY OF THE SYNOPTIC CLIMATOLOGY OF NORTH AMERICA

G. MORGAN, State Water Survey, Urbana, Illinois 61801

A project to develop a data bank and climatology of the conventional synoptic entities (surface fronts, squall lines, and pressure centers) over North America. The procedure employed consists of determining the diurnal frequencies of occurrence of the various synoptic features in 60x60-mile squares. When stored in digital form this information can be used in a variety of ways including study of 1) the distribution of frequencies of occurrence of the synoptic features by months or seasons; and 2) the distribution of frequencies of occurrence associated with particular severe weather phenomena, such as heavy rains and tornadoes in Illinois, to help explain their distribution. The frequencies, separated by months, and combined with other climatological data, can be used in multiple regression schemes to model the climatology of such severe weather hazards as thunderstorms, tornadoes, damaging winds, and hailstorms.

SUPPORTED BY Illinois State Government - Springfield

12.0035, PROBABILISTIC MODELING OF EXTREME LOADS

Y.K. IYEN, Univ. of Illinois, School of Engineering, Urbana, Illinois 61801

This project deals with probabilistic modeling and risk analysis of extreme environmental loads caused by tornadoes, hurricanes and earthquakes. The physical aspects of the natural phenomena which cause these loads are incorporated into the formulation and the occurrences of these loads are modeled by random processes. The results are presented in a form suitable for practical applications.

SUPPORTED BY University of Illinois

12.0036, DUST DEVIL METEOROLOGY

J.R. COOLEY, U.S. Dept. of Commerce, Natl. Weather Service, Kansas City, Missouri

Abstract: A complete analysis and understanding of the dust devil would provide new insight into the process within - and our ability to predict the behavior of - other larger, more destructive, and relatively elusive atmospheric circulations. This memorandum contains the history, morphology, and theoretical modeling of the dust devil. There is a tremendous change in the meteorological parameters across a horizontal and vertical cross-section of the dust devil; it represents a very sizeable amount of atmospheric energy when it releases the highly unstable superheated air from the boundary layer. Consequently, it may play a significant role in the heat transfer processes that take place in the atmosphere, particularly in the desert regions during months of large solar angles.

Pub. May 71: 39p., NTIS No. COM-71-00628: PC \$ 3.00 MF \$ 0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

Abstract: The log of all reports of severe storm 1956 through 1966 was used to determine a day for the area of the contiguous 48 States.

Pub. Sep. 71: 2p., NTIS No. COM-72-50079-03-09

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0038, BEHAVIOR OF WINDS IN THE 100 FEET IN CENTRAL OKLAHOMA - JUNE 1967

K.C. CRAWFORD, U.S. Dept. of Commerce, Storms Lab., Norman, Oklahoma

A television tower in northern Oklahoma City, Oklahoma, equipped with wind and temperature sensors at 6 levels ranging from 146 ft to 1458 ft above the base of the tower. Data are also obtained from a nearby tower 23 ft above the ground level and 40 ft above the base of the television tower. This report presents a year data sample consisting of the mean wind speed, direction and the highest recorded gust during each hour of the period per hour was used in this study.

The annual arithmetic mean wind speed increases with height at the surface to 18.7 kt at the top level. The mean wind speeds below the level at 296 ft are lowest at the surface, highest during the day, and the speeds above 1458 ft are lowest during the day and highest at night. Most change occurs in short time periods shortly after sunset and before sunrise.

Annual relative frequency distributions of wind speed are bimodal with most of the winds being either northerly or southerly. The primary peak occurs in the 10 degrees to 20 degrees centered on 180 degrees at the lowest 3 levels and 180 degrees at the upper 4 levels. The direction veers between the surface and top levels 80% of the time. At the higher the wind speed, the more likely the direction is southerly.

The direction of the annual resultant (vector mean) is 181 degrees at the lowest 4 levels and veers with height to 198 degrees at level 6. The resultant directions are nearly constant with height between 1700-1900 CST and between 1900-2100 CST. Winds at all levels veer between 2100 and approximately 1100 CST and with time during the remaining hours.

The variability of wind speed and direction is investigated using transition matrices (probabilities for change with time) and wind persistence (number of consecutive observations of winds blow from a given sector).

Wind shear speed is greatest in the lowest layer and decreases with height. Shear is dominant over direction in the lower 3 layers and a combination of speed and direction shear occurs in the upper 3 layers. The speed shear is most rapid near sunrise, reaches a minimum in early afternoon and increases rapidly near sunset. Shear is greatest in the lower 3 layers at night than during the day.

Pub. Aug. 70: 57p., ESSA Tech. Memo. ERL-70-11, NTIS.

Abstract provided by FIDAA.

SUPPORTED BY U.S. Dept. of Commerce - E.S.S.A.

12.0039, SOME STATISTICAL ASPECTS OF TORNADO SPOUT FORMATION - FLORIDA

J.H. GOLDEN, U.S. Dept. of Commerce, Natl. Se.

Lower Keys are primarily a rainy- season phenomenon. The diurnal distribution of water spout funnels (1958-1968) is shown graphically. The longest-lived funnel during the 1968 season lasted 52 min. A preliminary study was conducted using waterspout/ funnel statistics with the Local Climatological Data for Key West, May through September, years 1964-1968.

Pub. 1973: 13p., NTIS Order No. COM - 74- 10334/2. Reprint.
SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

12.0040, IMPACT OF THE LUBBOCK STORM ON REGIONAL SYSTEMS - TEXAS

J.E. MINOR, Texas Technological University, School of Engineering, Lubbock, Texas 79409

Abstract: Four major factors contributed to a study of the impact of disaster on regional systems: the relative isolation of the Lubbock economic region, the location of the city of Lubbock at the center of a vast commodity distribution network, the depth and diversification of the Lubbock economy, and the severity of the storm which struck the city on May 11, 1970. Conclusions developed from the investigation will be of interest to local civil defense directors and to civil defense operations personnel.

Pub. Jun. 72: 80p., NTIS No. AD-753 202: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

12.0041, COMPUTER SIMULATION OF SEVERE STORM OBSERVATIONS WITH DOPPLER RADARS

UNKNOWN, Tetra Tech Incorporated, Arlington, Virginia 22209

Abstract: A computer program developed for simulating the performance of severe storm observations with Doppler radars is described. The computer program consists of the main calling program, STORMS, six subroutines entitled POINT, SAMPLE, MONO, INVERT, GRID and INTGL, and one function subprogram, PIH. The liberal use of comment cards in the program source deck provides detailed documentation of interest to the programmer. The purpose of this report is to describe briefly, for the potential user, the capabilities of the program, the functions of the main program, subroutines and subprogram, and to document some results which have already been obtained by exercising the program.

Pub. Aug. 70: 30 p., NTIS No. COM-71-00020: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13. TSUNAMIS

DISASTER MITIGATION

13.0001, FREQUENCIES OF CREST HEIGHTS FOR RANDOM COMBINATIONS OF ASTRONOMICAL TIDES AND TSUNAMIS RECORDED AT CRESCENT CITY, CALIFORNIA

C. PETRAUSKAS, Univ. of California, School of Engineering, Berkeley, California 94720

Abstract: Of particular concern to the U.S. Army Corps of Engineers is the protection of Crescent City, California from fo-

tively, and the tsunamis caused millions of dollars of damage. Presently studies are being conducted by the Corps to determine the required height of a seawall fronting the ocean. This report presents a method for taking into account the occurrence of tsunamis with respect to the astronomical tides. The important parameter describing the tsunami's potential is assumed to be the maximum total water level during the occurrence of a tsunami. The total water level is assumed to be the sum of the tide water level and tsunami water level with respect to the tide. The method is applied to the 1960 and 1964 tsunamis that were recorded at the Crescent City tide gage at Dutton's Dock. The resulting histogram of the maximum total water level for each tsunami which can then be used to evaluate the severity of the tsunamis.

Pub. Mar. 71: 69p., NTIS No. AD-724 119: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

13.0002, GENERAL REVIEW OF THE SEISMIC HAZARDS TO SELECTED U.S. NAVY INSTALLATIONS

J.B. SEED, Calif. Inst. of Technology, Graduate School, Pasadena, California 91109

Abstract: The report summarizes the findings of the Hazards Review Panel whose mission it was to investigate the nature and magnitude of the threats posed to Naval bases by earthquakes and earthquake-related natural hazards including tsunamis, seiches (and the accompanying flooding, slides, mudflows and soil foundation failures which result from earthquakes). In addition to citing the problems for Naval bases in the San Francisco, San Diego and the Manila areas, the introduction to this report recommends conducting a rapid visual survey initially to determine the nature of various danger areas. It then recommends a follow-on procedure leading to various strategic engineering decisions which will provide the required degree of protection to insure Fleet Operational Readiness and wide cost effectiveness in protecting the Navy against earthquake damage.

Pub. Jan. 74: 45p., NTIS No. AO-778 005/9: PC \$3.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Navy

13.0003, URBAN GEOLOGY PLAN FOR CALIFORNIA: THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, landslides, mineral resources to urbanization, landsliding, flooding, erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of possible reduction measures, and agencies responsible for those measures.

Pub. Jun 73: 111p., NTIS No. PB-222 447/5: PC \$7.50 MF \$1.45.

Technical objective: Through analysis of earthquake fault mechanisms, establish the causative mechanism of tsunami generation. Once done, the incorporation of such understanding into the tsunami warning network will greatly strengthen the warning capability of this network program.

Approach: Refine the statistical and physical models by which earthquake fault mechanisms are analytically determined such that meaningful correlation with the generation of tsunamis can be observed.

Progress: Both the statistical and physical models for solution of earthquake fault mechanisms have been greatly improved; this is being documented in several journal articles.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13.0005, TSUNAMI RESEARCH

G.R. MILLER, U.S. Dept. of Commerce, Environ. Research Laboratories, Boulder, Colorado 80302 (2C650128)

Research/service objective: To improve our understanding of the generation, propagation, and run-up mechanisms of tsunamis from the view point of basic knowledge and to improve the operation of the Tsunami Warning System.

Research/service plan: Continue development of tsunami gauges in addition to analytic and numeric development of tsunami propagation. Installation of gauges under ocean station 'Papa'; installation of magneto-telluric sight in Bermuda in connection with Project MODE.

Progress report: Installation of a magneto-telluric sight at Ewa Beach. Deep ocean wave records obtained in vicinity of Amchitka Island. Numerical work completed on harbor resonance, wave shoreline interaction and on harbor and shelf resonance.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13.0006, TRANS-ALASKA PIPELINE - SUPPLEMENTAL EXHIBITS AND TESTIMONY - VOLUME V

UNKNOWN, U.S. Dept. of the Interior, Washington, District of Columbia

Abstract: Presented are data pertinent to the construction of a marine terminal at Valdez, Alaska for the Trans Alaska Pipeline. The contents include: Feasibility study for the construction of dock facilities; Study concerning effects of the 1964 Tsunami at the site; Environmental study baseline survey for Port Valdez; Measurement of water current direction and velocity at the site (Jackson Point) Port Valdez; Aseismic Design Study; Model studies report; Floating dock, Valdez, Alaska; Collection of temperature and wind data for the site from 1968 to present.

Pub. Feb. 71: 595p., NTIS No. PB-201 356 PC \$6.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

13.0007, WAVE REPORTING PROCEDURES FOR TIDE OBSERVERS IN THE TSUNAMI WARNING SYSTEM

M.G. SPAETH, U.S. Dept. of Commerce, Natl. Ocean Survey, Rockville, Maryland 20852

Abstract: The Tsunami Warning System provides tsunami warning information to the civilian population and military personnel of the Pacific region. Although a cooperative effort of international scope, the responsibility for developing, administering, and operating the Warning System is assumed by the Coast and Geodetic Survey, Environmental Science Service, and the National Oceanic and Atmospheric Administration.

Instructions to aid observers in reporting tsunamis.

Pub. Jun 70: 48p., NTIS No. COM-71-00170: PC SOD MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13.0008, TSUNAMI TRAVEL-TIME CHARTS FOR USE IN THE TSUNAMI WARNING SYSTEM REVISED 1971 EDITION

UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey, Rockville, Maryland 20852

Abstract: The time required for a tsunami to reach a given station from an earthquake whose epicenter is within the area covered by the time curves can be obtained by plotting the location of the epicenter on the chart and noting its position with respect to the time curves.

Pub. Jun. 71: 53p., NTIS No. COM-71-00918: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13.0009, STABILITY OF RUBBLE-MOUND TSUNAMI BARRIER HILO HARBOR, HAWAII. HYDRAULIC MODEL INVESTIGATION

A.M. KAMEI, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: Six series of tests were conducted on 1:50-scale models of rubble-mound barrier truck sections to obtain design criteria for rehabilitation of the existing barrier and construction of a new one at Hilo Harbor, Hawaii. The model test sections were subjected to the attack of tsunamis and short-period waves. Proposed designs involved overtopping and nonovertopping barrier sections with protective cover layers of quarystones and tribars.

Pub. Aug. 67: 135p., NTIS No. AD-721 961: MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

13.0010, STEADY-FLOW STABILITY TESTS OF NAVIGATION OPENING STRUCTURES, HILO HARBOR, TSUNAMI BARRIER, HILO, HAWAII - HYDRAULIC MODEL INVESTIGATION

N.R. OSWALT, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: Steady-flow tests of navigation opening structures in the Hilo Harbor tsunami barrier were conducted to determine the effect of tsunami-induced high-velocity currents through the navigation opening on stability of the barrier heads. Tests were conducted in a 1:60-scale model which reproduced one-half of the navigation opening and a 1:72-scale model which reproduced the full opening. Steady flow through the opening with a head differential of 28 ft across the barrier was the basic test flow, representing the peak flow condition caused by the design tsunami. Tests were designed to determine the cover-stone size required on the barrier heads for stability under this steady-flow condition and also to investigate methods for providing toe protection for barrier heads constructed on sand. Results of the steady-flow tests were to be correlated with results of model tests concerned with wave action and with factors to develop the optimum design of the tsunami barrier.

Pub. Oct. 66: 53p., NTIS No. AD-720 981: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

13.0011, TSUNAMI SYSTEMS ENGINEERING

The Tsunami Seismic Engineering Program was initiated and sponsored by NOAA. The work for design, development, test and evaluation for one prototype tide sensor and one prototype seismic sensor at the Albuquerque Seismological Center is in conjunction with an interagency agreement between USGS and NOAA. The prototype tide sensor will collect in digital form the analog tide data. An interrogation command over the GOES system will cause the tide sensor to transmit back over the GOES system the last forty words of tide data. The prototype seismic sensor will detect large seismic events and record time of first arrival. This will activate a tsunami alarm signal that will be transmitted over the GOES system. The station will also respond to interrogation commands and will transmit the last four time of arrival data words over the GOES system. Also, under agreement with NOAA the Albuquerque Seismological Center will provide general support for all existing TWS seismic stations.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

HAZARD REDUCTION

13.0012, EVALUATION OF LONG PERIOD SURFACE WAVES IN THE GULF OF ALASKA

T.C. ROYER, Univ. of Alaska, Inst. of Marine Sciences, Fairbanks, Alaska 99701

A station will be established on Middleton Island in the Gulf of Alaska to collect and analyze wave data. It is expected to provide information about all long waves, but is particularly suited to investigate the existence of small amplitude tsunamis generated by low magnitude earthquakes. Wave data obtained at this station would possess a minimal amount of contamination due to normal mode and continental effects. Records from this station will be part of an array at other similar island stations, to provide a measure of the wave dispersion. Analysis of the data records will also provide an estimate of the ability to measure continental shelf oscillations and edge waves from such a station.

SUPPORTED BY U.S. Natl. Science Foundation

13.0013, ALASKA GEOLOGIC EARTHQUAKE HAZARDS

G. PLAFKER, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: Alaska.

The specific project objectives are to reduce and evaluate risk in Alaska from tectonic displacement, seismic shaking, and secondary geologic effects. A more general goal is to gain an insight into tectonic processes within the seismically active zone of southern Alaska.

Initially, research efforts will be concentrated in the highly seismic southern part of the State where most of the population and economic development are concentrated. This research will later be extended into the southeastern and central parts of the State. Geological research under this project will be closely coordinated with parallel geophysical projects by the Office of Earthquake Research.

The geologic studies will involve: 1) preparation of detailed maps of active surface faults and evaluation of geologic evidence for late Cenozoic fault movement; 2) delineation of coastal areas that may be subjected to major earthquakes characterized by large-scale regional tectonic elevation changes and assessment of the hazards related to such movements (notably seismic shaking, tsunamis, seiches, and regional warping); 3) identification and evaluation of secondary geologic hazards related to seismic shaking in critical areas.

spreading and compaction); and OERCS) of a synthesis of pertinent processes in the seismically active transform fault system in southeast Alaska, northeast extension of the Aleutian into south-central Alaska, to provide within which earthquake hazards in south Alaska are evaluated.

SUPPORTED BY U.S. Dept. of Interior

13.0014, ACTIVE FAULTS AND GEOMORPHOLOGY OF THE PT MUGU TO WILMINGTON, CALIFORNIA

H.C. WAGNER, U.S. Dept. of the Interior, Menlo Park, California 94025

States to which project pertains: California

Topical studies related to earthquake hazards in the California borderland, with geologic and geomorphic evaluation spinoff. Major objective of project is to construct the depositional and structural history of the borderland in order to determine the age and kinematics of offshore faults as a means of evaluating earthquake hazards, tsunamis, landslides, or slides to building construction or to major infrastructure growth. The geologic studies will provide a means of evaluating the borderland and will provide a means of evaluating subsurface economic resources (e.g., oil, gas, phosphate, manganese, oil and gas).

SUPPORTED BY U.S. Dept. of Interior

13.0015, TSUNAMI RESEARCH AND APPLICATIONS

L. HWANG, Tetra Tech Incorporated, 91107

This project will undertake the development of a model and computational methodology that is capable of describing: (1) tsunami generation; (2) wave propagation including directivity, transverse displacement, depth, dispersion, and so forth; (3) coastal response features, and inundation of coastal areas. Particular attention will be devoted to the generation of tsunami waves near the source, and the propagation of the wave parallel to the coast.

SUPPORTED BY U.S. Natl. Science Foundation

13.0016, NAVY ENVIRONMENT - IMPACT OF GENERATION OF OCEAN WAVES AND RESPONSE OF HARBORS TO TSUNAMI LONG WAVES

J.W. MILES, Univ. of California, Inst. of Marine and Coastal Sciences, San Diego, California 92038

The Navy has a continuing requirement for understanding of the creation and behavior of ocean waves since knowledge of the phenomena takes on increasing importance in the environment has application to ship navigation. The results of this research on ocean waves and their interactions, will be used to more accurately predict wave actions in a number of Naval applications, such as in the design of harbors, and in the

Research will continue on wave generation and hydrodynamic stability with particular emphasis on the resonant response of harbors to tsunamis and other long waves.

Supporting agency address information: Office of Naval Research 438, Arlington, Va. 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

13.0017, ENGINEERING GEOLOGY RECONNAISSANCE STUDIES OF COASTAL COMMUNITIES, ALASKA

R.W. LEMKE, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Alaska.

Reconnaissance engineering geology studies, directed principally toward assessing potential earthquake and other geologic hazards, have been completed in the following Alaska coastal towns: Skagway, Haines, Sitka, Ketchikan, Metlakatla, Petersburg, Wrangell, Yakutat, Hoonah, Nome, Bethel, Dillingham, Naknek-King Salmon, Unalakleet, Kotzebue, and Barrow. It is concluded that most parts of these towns are built on more stable geologic materials than those beneath towns heavily damaged by the 1964 Alaska earthquake. Nevertheless, in the event of a large earthquake, some communities are susceptible to damage because of amplified shaking in poorly consolidated deposits, slides of rock and snow, ground fissuring, flowing sediments caused by liquefaction, and subsidence due to soil compaction. In addition, harbor areas and other low-lying parts of some towns may be damaged by vertical changes in the land, by seismic sea waves, and by other abnormal waves produced locally by land tilting or by submarine landsliding.

Reports on the southeastern Alaska region, Haines, and Skagway have been released in open file, and reports are in various stages of preparation for the other communities. As of early 1973, this large project has been restructured, and report preparation responsibilities for Sitka, Metlakatla, Hoonah, Yakutat, Bethel, Naknek-King Salmon, and Unalakleet assigned to project 9550-00948.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

13.0018, RECONNAISSANCE ENGINEERING GEOLOGY OF THE SITKA AREA, ALASKA

J.T. MCGILL, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Alaska.

A reconnaissance engineering geology report on the Sitka area, Alaska, will be released in open files in 1974. It emphasizes possible effects of future major earthquakes and also evaluates other geologic hazards. Although the report notes that little damage occurred during the nearby July 30, 1972, earthquake of magnitude about 7.3, earthquake effects during future earthquakes might include sudden tectonic displacement of land, ground shaking, liquefaction of certain granular deposits, ground fissuring, differential compaction of some surficial deposits, and various types of slope failures; low-lying ground might be inundated by seismic sea waves or other earthquake-caused water disturbances. Geologic hazards other than earthquakes include stream flooding, storm waves and other high waves, landsliding, and possible volcanic eruptions.

A reconnaissance engineering geologic report on the Metlakatla area, Alaska, is in preparation. Reconnaissance reports are planned for the following coastal communities in Alaska:

UNKNOWN, U.S. Army, Coastal Engin. Res. Center, Washington, District of Columbia 20016

Purpose of study/investigation: To gain an improved understanding of the creation, propagation and transformation of long waves; particularly tides, storm and hurricane surges, and tsunamis.

Approach or plan: Research and development on long-period waves and surges including theoretical, laboratory, and field studies of surging in harbors; the prediction of changes in tidal currents and heights caused by changes in channels and basins; the prediction of storm surge heights at coastal locations; and the generation, travel, and effects of tsunami waves.

Progress to date: In-house efforts included storm surge calculations, in which the grid system was established for the two-dimensional mathematical model of long-wave propagation in Pamlico Sound, and a one-dimensional numerical solution for the 'enclosed basin surge problem' was developed and included in the forthcoming CERC shore protection manual, and supervision of WES activities in connection with mathematical models of harbor surges and University of California's efforts in connection with tsunami studies. Contract studies on storm surge calculations included numerical studies of gravity waves by Texas A and M University in which a mathematical storm surge model for computing water levels in Lake Okeechobee was formulated along with a supporting computer program, and Hillsborough Bay digital computer model is being verified by the University of Southern Florida. Three reports pertaining to tsunami studies were received from the University of California. Study of two-dimensional long waves by Texas A and M University has resulted in a final report and six earlier reports and six papers in scientific journals.

SUPPORTED BY U.S. Dept. of Defense - Army

13.0020, NUMERICAL SIMULATION OF TSUNAMIS

C.L. MADER, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Honolulu, Hawaii 96812

Abstract: Two-dimensional, time-dependent, nonlinear, incompressible, viscous flow calculations were performed of realistic models of tsunami waves interacting with continental slopes and shelves. Wave heights were observed to grow by a factor of 4 as they shoaled up a 1/15 continental slope. The second or third wave often exhibited the largest wave run-up. Comparisons with shallow water, long wave calculations showed similar results except for short wavelength tsunamis. The damping action of submerged barriers on tsunami waves was investigated. Significant amounts of the energy of a tsunami may be reflected by submerged barriers. The numerical simulation of tsunami waves can provide realistic descriptions of their flow.

Pub. Feb. 73: 56p., NTIS No. COM-73-11321/9: PC \$5.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13.0021, PACIFIC TSUNAMI CATALOG

D.C. COX, Univ. of Hawaii, School of Arts, Honolulu, Hawaii 96822

A catalogue of tsunamis that have occurred in the Pacific Ocean will be prepared that collects all recorded and observed data available. The catalogue and subsequent analysis will be completed with cooperation of Japanese and Russian collaborators. The data base will be analyzed for the following:

G.R. MILLER, Univ. of Hawaii, Hawaii Inst. of Geophysics, Honolulu, Hawaii 96822

Abstract: The departures in the spectra of tsunamis at a fixed station are compared to the normal tsunami spectrum at this station. By examining these spectral ratios, one removes the effect of local resonances and compares the generation spectra for different locations. The spectral ratios are smooth as compared to the spectra themselves, thus indicating an absence of strong resonances in the relatively rich in low frequencies.

Pub. May 72: 21p., NTIS No. COM-72-11261. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13.0023, RECENT TSUNAMI THEORY

R.W. PREISENDORFER, Univ. of Hawaii, Hawaii Inst. of Geophysics, Honolulu, Hawaii 96822

Abstract: Recent developments in the mathematical analysis of tsunami development are discussed. Five main phases of the tsunami development are described and modeled. These phases are: generation and uniform propagation; scattering and diffraction; guiding, trapping, and radiation; oscillations and resonances; and shoaling, breaking, and run up.

Pub. Aug. 71: 59p., NTIS No. COM-72-10105. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13.0024, TSUNAMI SHORELINE TRACT

G.P. WOOLLARD, Univ. of Hawaii, Hawaii Inst. of Geophysics, Honolulu, Hawaii 96822 (216502021)

Technical objective: Examine effects of shorelines where tsunami waves interact with irregular features such as harbors, points and generally varying topography.

Approach: Modify existing numerical techniques and apply them to the tsunami generation and run-up problem in two dimensions. Solution of the three dimensional topography problem should be started during this research year.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

13.0025, THE MAJOR TSUNAMI IN THE HAWAIIAN ISLANDS

UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey, Rockville, Maryland 20852

Abstract: The March 28, 1964, tsunami caused little damage and no loss of life in Hawaii. The highest water levels were generally about 10 ft on the northern or exposed shores of the islands, locally up to 16 ft. Maps of runup heights are shown. The successive crests of the tsunami quickly became out of phase with natural modes of Hilo Bay so that the 'Hilo Tsunami Problem' did not materialize. Energy, coherence, and quadrature spectra of the tsunami at Midway, Honolulu, Kahului, and Hilo are shown. The low coherence between these stations does not support the hypothesis that a coherent source of waves was emanating from the Gulf of Alaska. The energy decay curve has several peaks that can be identified with reflections from North America, Kamchatka, Mexico, and Australia. The mean frequency of the incoming energy changes with time in a peculiar way, but not so as to support the hypothesis that energy is being converted from lower to higher frequencies, at least during the initial phase of the tsunami.

G.H. KEULEGAN, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The important wave parameters to be considered in tsunami model studies are wave height and period, and front orientation. The first two of these parameters are determined by marginographic measurements or by visual observations; however, wave-front orientation has never been accurately observed at the problem site (Crescent City, Calif.). A digital computer program was written to plot wave-fronts from three recent epicentral locations to Crescent City to obtain approximate tsunami-front orientations. The resulting diagrams were checked by comparing the computed initial arrival times of the wave fronts. The actual arrivals were obtained from recording tide stations at Crescent City and Hilo, Hawaii. Initial wave-front orientations relative to earthquake epicenter were either assumed or taken from the literature. A tentative frequency relation was derived from a risk-duration relation was prepared from the frequency relation. The selected values of the test-wave dimensions (height and period) and orientation determine, to a considerable extent, the model configuration necessary to ensure results sufficiently accurate for purposes of the model study. Since experience in the design and operation of long-period tsunami models is scant, it was deemed necessary to conduct preliminary tests utilizing a pneumatic wave generator in a two-dimensional flume. The results of these tests were compared with theoretical predictions from an idealized mathematical model and on the basis of these tests, a preliminary model design was proposed.

Pub. Jun. 69: 118p., NTIS No. AD-723 965. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

13.0027, A REVIEW OF THE EXPERIMENTAL DATA RELATIVE TO THE PILOT MODEL STUDY FOR THE DESIGN OF HILO HARBOR TSUNAMI MODEL

G.H. KEULEGAN, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Abstract: The report examines the motion of the sea off Hilo Bay, Hawaii prior to a pilot model study for the design of Hilo Harbor tsunami model.

Pub. Apr. 67: 48p., NTIS No. AD-735 844. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

13.0028, TSUNAMI PREDICTIONS FOR PACIFIC COASTAL COMMUNITIES - TYPE 16 FLOOD INSURANCE STUDY

R.W. WHALIN, U.S. Army, Waterways Experiment Station, Vicksburg, Mississippi 39180

Purpose of study/investigation: To predict the runup along the southern coast of California and three sites in Alaska from possible tsunamis occurring in the Pacific Ocean for flood insurance studies.

Approach or plan: To delineate probable areas of coastal inundation from tsunamis at various locations in California and Alaska. A detailed refraction analysis will be made of the propagation of a design tsunami from various seismic regions of the Pacific Ocean to the coastal areas of interest. Various 'state of the art' numerical techniques applied to tsunami generations, propagation, and runup over the Pacific Ocean will be utilized in this study.

MAJOR DISASTER TYPES

14.0004,

Progress to date: An extensive literature survey of tsunamis was completed. Water depth grids for deep ocean areas were established and historical data and wave refraction diagrams of the offshore southern California area were studied to aid in determining design tsunami source areas used as input to the tsunami generation program. Deep ocean wave refraction diagrams for tsunamis originating in both South America and Alaska have been completed. The tsunami generation and deep ocean propagation computer program developed by Tetra Tech, Inc., has been successfully utilized for test cases of tsunamis generated in Alaska and will be utilized for tsunamis generated in other areas.

SUPPORTED BY U.S. Dept. of Defense - Army

13.0029, THE PROPAGATION OF LARGE AMPLITUDE TSUNAMIS ACROSS A BASIN OF CHANGING DEPTH - OFF-SHORE BEHAVIOR

E. PARLEY, Lehigh University, Ctr. for the Appl. of Math., Bethlehem, Pennsylvania 18015

Abstract: A theory is presented which describes the propagation of large amplitude Tsunamis across a basin of variable depth in the limit when this depth is varying slowly on a scale defined by the wavelength. In Part I only the off-shore behavior is considered, in Part II some features of the final runup are described. The technique used is to regard the wave as a slowly modulated simple wave with a slowly changing Riemann invariant. One of the most significant results is that over distances where the effect of depth variation modulates the amplitude of the wave, but does not disperse it, the variations of the amplitudes of the flow variables, such as maximum surface elevation, can be calculated as functions of the undisturbed depth without knowing how this depth varies in distance and without knowing the wave profile.

Pub. Jun. 71: 52p., NTIS No. AD-730 376; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

14. VOLCANOES

PUBLIC ASSISTANCE

14.0001, VOLCANIC HAZARDS ON THE ISLANDS OF HAWAII

D.R. MULLINEUX, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Assemble scientific and technical data and experience to assist the establishment of criteria for guiding HUD participation in areas with volcanic hazards on the Islands.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

DISASTER MITIGATION

14.0002, SATELLITE VOLCANO SURVEILLANCE

tion was completed in 1972 on the volcanoes St. Augustine and Iliamna in Alaska, Kilanea in Hawaii, Baker, Rainier and St. Helens in Washington, Lassen in California, and at a site near Reykjavik, Iceland. Installation continues and should be completed in April 1973 on the volcanoes Santiaguito, Fuego, Agua and Pacaya in Guatemala, Izalco in El Salvador and San Cristobal, Tebea and Cerro Negro in Nicaragua. The data available to date show that the instruments are working quite reliably.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0003, URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, loss of mineral resources to urbanization, landsliding, flooding, erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of possible loss-reduction measures, and agencies responsible for those measures.

Pub. Jan. 73: 111p., NTIS No. PB-222 447/5 PC \$7.75 MF 1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

14.0004, HAWAIIAN VOLCANO OBSERVATORY

D.W. PETERSON, U.S. Dept. of the Interior, Geological Survey, Honolulu, Hawaii 96814

States to which project pertains: Hawaii.

Despite their reputation for mild activity, Hawaii's basaltic volcanoes pose a continual threat to life and property, and major aims of the Hawaiian Volcano Observatory are to provide warnings of impending eruptions and advice about volcano-related hazards. To achieve these aims, a wide variety of geologic, geophysical, and geochemical studies are carried out to improve the understanding of volcanic processes. Eruptions are studied in great detail, including describing and recording eruptive events and associated phenomena, sampling eruptive products, making photographic records, and mapping vents and flows. Seismic activity is continuously monitored by a network consisting of about 36 stations. Several thousand earthquakes are recorded annually, and their locations and magnitudes are determined by computer. Vertical and horizontal ground deformation is measured by regularly reoccupying tilt stations, leveling lines, and a triangulation network of geodimeter stations. Additional

DOUBT AND SPURR VOLCANOES, COOK INLET, ALASKA

J. KIENLE, Univ. of Alaska, Geophysical Institute, College, Alaska 99735

Very little data exists on the eruptive behavior of Alaskan volcanoes. This project is to improve the seismic surveillance of Augustine Volcano and to initiate similar surveillance systems at Redoubt and Spurr. All three are active volcanoes. By locating hypocenters in space and time, one may be able to determine the source of magma generation, path of magma migration and magma storage areas.

SUPPORTED BY U.S. Natl. Science Foundation

14.0006, GEODIMETER STUDIES OF CASCADE VOLCANOES - WASHINGTON, OREGON AND CALIFORNIA

D.A. SWANSON, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

Small geodimeter networks are being installed and measured on several Cascade volcanoes in order to monitor possible ground displacements before future eruptions. The networks will be remeasured periodically, probably every 2 to 4 years unless conditions warrant otherwise. Some or all of the following volcanoes will be monitored: Washington (Baker, Rainier, St. Helens, Adams); Oregon (Hood, Jefferson, Belknap Crater area, Sisters, Crater Lake); California (Shasta, Lassen). The networks involve triangles or quadrilaterals several kilometers on a side. Strain parameters will be computed, and displacements of stations on the volcano will be determined relative to stations on bedrock away from the volcano.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0007, VOLCANIC HAZARDS IN THE CASCADE RANGE - CALIFORNIA AND WASHINGTON

D.R. CRANDELL, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

Volcanic rocks and surficial deposits of postglacial age are being studied and dated at Lassen Peak and Mount Shasta in California, and Mount St. Helens and Mount Baker in Washington in order to infer the kinds and frequency of the events they represent and the areas affected, for the purpose of evaluating potential geologic hazards at communities, campgrounds, and reservoirs that could be affected. Maps are being prepared where needed to show areal distribution of various kinds of hazards. Where appropriate, recommendations are made to responsible authorities concerning actions to be taken prior to and during volcanic eruptions in order to minimize danger to life and property.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0008, THERMAL SURVEILLANCE OF VOLCANOES - REMOTE SENSING OF LONG VALLEY IN GEOTHERMAL PROGRAM - WASHINGTON, OREGON AND CALIFORNIA

J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

Under the auspices of a comprehensive geothermal remote sensing project, the present project is designed primarily to test and evaluate aerial, and where suitable, satellite infrared scanning techniques and concomitant ground observations in geothermal studies, both as reconnaissance and mapping tools. The goal of this project is (1) to utilize quantitative

anomalous heat flow measurements from surface manifestations of anomalies in relation to structure and geophysical anomalies and (3) ultimately to determine radiative and other energy loss from the terrestrial surface in geothermal areas. In application of these techniques to volcanic systems the goal is similar, and in addition, we shall estimate minimum thermal energy yields during repose periods of volcanoes, as a base of reference for comparison with future periods of activity and as an aid in understanding the overall energy budget of volcanic systems.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0009, THERMAL SURVEILLANCE OF ACTIVE VOLCANOES

J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

Abstract: The author has identified the following significant results. By the end of 1973, aerial infrared scanner traverses for thermal anomaly recordings of all Cascade Range volcanoes were essentially completed. Amplitude level slices of the Mount Baker anomalies were completed and compiled at a scale of 1:24,000, thus producing, for the first time, an accurate map of the distribution and intensity of thermal activity on Mount Baker. The major thermal activity is concentrated within the crater south of the main summit and although it is characterized by intensive solfataric activity and warm ground, it is largely subglacial, causing the development of sizable glacier perforation features. The outgoing radiative flux from the east breach anomalies is sufficient to account for the volume of ice melted to form the glacier perforations. DCP station 6251 has been monitoring a thermally anomalous area on the north slope of Mount Baker. The present thermal activity of Mount Baker accounts for continuing hydrothermal alteration in the crater south of the main summit and recurrent debris avalanches from Sherman Peak on its south rim. The infrared anomalies mapped as part of the experiment SR 251 are considered the basic evidence of the subglacial heating which was the probable triggering mechanism of an avalanche down Boulder Glacier on August 20-21, 1973.

Pub. Jan 74; 6p., NTIS No. E74-10418; PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

14.0010, VOLCANIC HAZARDS, ISLAND OF HAWAII

D.R. MULLINEAUX, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

States to which project pertains: Hawaii.

The frequency of volcanic eruptions, and the distribution and effects of eruptions and of associated ground movements, are reviewed in order to delineate several zones on the island that have different relative exposure to direct or indirect volcanic hazards. In preparation are a map that shows zones of relative exposure to such hazards, and an accompanying report that describes the hazards, their effects, criteria used to delineate the hazard zones, and the kinds of volcanic activity typical of the island of Hawaii.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0011, EASTERN SNAKE RIVER PLAIN REGION INVESTIGATIONS - IDAHO

S.S. ORILL, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

Principal objective is to coordinate Survey investigations and to encourage other geologic studies of the Snake River Plain region for the derivation of land resource information useful to planners and decision makers.

Aims are: To minimize earthquake, slide, and volcanic hazards in this northern part of the Wasatch seismic belt. To help in the development of wise environmental policies for extensive public lands. To provide data for planning and management of this balanced agricultural and urban region, a populous and growing part of Idaho. To develop a better geologic framework for aquifer and waste-disposal models of a region where increasing wastes threaten a major aquifer. To evaluate the mineral resource and geothermal potential of the region.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0012, SNAKE RIVER PLAIN, PART E - NORTH CENTRAL - IDAHO

D. SCHLEICHER, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

This project is part of a study of the eastern Snake River Plain, whose aim is to gather geologic data needed for land-use planning. I plan to prepare one or more maps at scales 1:250,000 and larger showing geologic units and structures that represent hazards or resources. In the core of the Beaverhead Mountains, the main emphasis will be on working out the stratigraphy as to decipher the structures that can be extrapolated beneath the volcanic rocks of the Snake Plain. On the surrounding flats and the flanks of the range, the plan is to map the young volcanic rocks and sediments, to identify and date young faults and volcanic eruptions, and to note other potential hazards.

The study area is bisected by the southern end of the Beaverhead Mountains, which are cored by Mississippian and Pennsylvanian carbonates and quartzites, whose stratigraphy remains poorly known. The rocks are slightly to severely deformed, with local complex folding and thrusting. The range is separated from the surrounding flats by range-front faults; the faults are probably younger on the west side of the range than on the east where they are mantled by ashflow tuffs intercalated with tuffaceous, partly cemented fan gravels that are probably a few million years old. The absence of young faults accords with the absence of epicenters reported here during this century. The area has geothermal potential, reflected by Lily Hot Springs and the springs feeding Warm Creek, and suggested by a hitherto unrecognized intrusive plug at the south end of the Beaverheads. Extensive alluvial aprons may yield water, and areas of silty soil (reworked loess?) may prove arable.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0013, SNAKE RIVER PLAIN, PART B - VOLCANIC ROCKS - IDAHO

P.L. WILLIAMS, U.S. Dept. of the Interior, Geological Survey, Denver, Colorado 80225

The purpose of the project is to geologically map, at scales of 1:250,000 and larger, the volcanic rocks of the eastern Snake River Plain and its margins. Major scientific objectives are to delineate the late Cenozoic volcanic and tectonic history in detail, to locate eruptive centers for basalt flows and for

mental aspects of trace element distribution, aquifers and liquid waste disposal sites, potential recreation areas, and other topics needed for land-use planning.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0014, REGIONAL VOLCANOLOGY - WESTERN UNITED STATES INCLUDING ALASKA AND HAWAII

R.L. SMITH, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

This project is an inquiry into the nature of the relationship between volcanism and geothermal resources. An attempt will be made to discover what, if any, systematic relationships exist among specific types of volcanic systems, hydrothermal systems, and geothermal anomalies. The project is oriented toward the development of criteria that may be useful: 1. as guides for geothermal exploration, 2. for better understanding of volcanic activity and processes, 3. for the conceptualization of magma chamber models.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

14.0015, RAINWATER CONTAMINATION BY VOLCANIC VOLATILES FROM KILAUEA VOLCANO, HAWAII (PHASE I)

J.B. FINLAYSON, Univ. of Hawaii, Water Resources Research Ctr., Honolulu, Hawaii 96822

The proposed research plan involves field and laboratory studies to determine the extent and type of contamination that occurs in rainwater, resulting from the injection of volcanic fume (gases and particulates) into the atmosphere by Kilauea volcano. Initially, only sulfur dioxide and hydrogen, sulfate and fluoride ions, known components of the fume, will be studied.

Field work would involve the establishment and operation of sampling-monitoring stations (minimum of four) for the following purposes: 1. Collection of rainwater (and fog drip), gas and particulate samples in areas downwind from the volcano. 2. Meteorological monitoring (wind speed and direction, etc.) to determine the distribution of fume and rainwater in the areas of study.

Laboratory work would include the following: 1. Analysis of collected samples by conventional methods, modified as needed for this study. 2. Continued development of new or existing methods for the collection and analysis of the type of samples to be encountered in the project.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

14.0016, SEISMIC ACTIVITY OF THE CASCADIAN VOLCANOES

S.W. SMITH, Univ. of Washington, School of Arts, Seattle, Washington 98105

Earthquakes directly associated with volcanoes are several basic types. One type is indistinguishable from ordinary tectonic earthquakes produced by faulting. These are usually scattered around the volcano with focal depths of 1-20 kilometers. A second type is the volcanic, or type 'B' earthquake which is usually located at a shallow depth near the volcano's summit. The envelope of such an event consists of an emergent arrival and a more gradual decrease in amplitude. The mechanism for these events has never been adequately explained. Both of these types of volcanic

15.0001, COMPOSITE MATERIALS FOR OCEAN CONSTRUCTION

A.S. TETELMAN, Univ. of California, School of Engineering, Los Angeles, California 90024

Objectives: The objectives of this project are to investigate the possibility of using high-strength composite materials in ocean construction, to provide long-life low-cost coastal constructions and facilities. This involves study of both the properties needed for such structures, and the factors controlling fracture in appropriate materials in the salt-water environment.

How information will be applied: In the building of new marinas and public beaches, erosion can be controlled by construction of jetties, groins and breakwaters; tough corrosion resistant composite material shows promise for containment of fill material for more economical construction.

Accomplishments during the past twelve months: Established a strain-rate effect on the fracture load of notched and unnotched polymer-impregnated concrete. Studies of crack propagation rates in plain and polymer-impregnated concrete as a function of environment have been initiated. Corrosion studies on P.V.C. coated wire mesh exposed for 10 years in seawater is in progress.

For additional information pertaining to this project contact Dr. George G. Shor, Jr., Scripps Institution of Oceanography, La Jolla, California 92037.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

15.0002, FLOOD AND SEDIMENT REDUCTION IN STEEP UNSTABLE BRUSSLANDS OF THE SOUTHWEST

R.M. RICE, U.S. Dept. of Agriculture, Pac. S.W. For. & Rg. Exp. Sta., Riverside, California 92507 (PSW1604)

Objective: Gain understanding of runoff and erosion processes of steep, unstable mountain chaparral watersheds and their contribution to downstream floods and sedimentation. Develop effective land management practices to combat excessive runoff and erosion, as emergency following fires and for long-term environmental stability.

Approach: Excessive post-fire erosion attacked by studying hydrophobic soils, their chemical-physical nature and relations, and tests of measures to counteract them. Long-term environmental stability sought by ecological approach, including study of site potentials. Relationships between storms and floods studied by investigation of processes, and development of estimation techniques through analyses of existing watershed data.

Progress: Soil water repellency is a frequently encountered site factor that can influence the success of various forestry practices. Severe water repellency is usually the result of fire, but humus and its related microorganisms may also produce repellency. Water repellency may induce excessive runoff and erosion in a burned area. Water repellency also affects relations between soil, water and plants. Adverse affects of water repellency can be eliminated by mechanically disrupting the water-repellent barrier. Under some conditions, treating the affected areas with wetting agents may soon be feasible. A survey of water-repellent conditions is desirable for appraisal of a forest site for various cultural practices. A wetting agent was applied by sprinkler irrigation to a burned watershed as an erosion control measure. The wetting agent decreased production of mustard (*Brassica* spp.) and in-

icated that the wetting agent suppressed growth of mustard seedlings and had a less suppressive effect on ryegrass seedlings. The differential physical properties are presumably responsible for much of the difference in mustard and ryegrass seedling establishment in the burned area.

SUPPORTED BY U.S. Dept. of Agriculture - Forest Service

15.0003, URBAN GEOLOGY PLAN FOR CALIFORNIA: THE NATURE, MAGNITUDE, & COSTS OF URBAN GEOLOGIC HAZARDS & RECOMMENDATIONS FOR HAZARD MITIGATION (ABBREVIATED)

J.T. ALFORE, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threatened \$55 billion loss in California's urban areas by the year 2000. The problems are earthquake shaking, landsliding, mineral resources to urbanization, landsliding, erosion activity, expansive soils, fault displacement hazards, tsunami hazards, and subsidence. This report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of various reduction measures, and agencies responsible for their implementation.

Pub. Jun 73: 111p., NTIS No. PB-222 447/5: \$1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

15.0004, CONCRETE BLOCK REVENUE BENEDICT, MARYLAND

J.V. HALL, U.S. Army, Coastal Engin. Res. Center, District of Columbia 20016

Abstract: Although the project has been completed in one year, it has protected the backshore area from winter storms. Figure 9 shows comparative photographs before and during construction, at completion, and later. The problem of protecting banks and lower reaches of rivers entering Chesapeake Bay, has always been difficult since the problem areas consist of small parcels of land in individual ownership. Many owners expend large sums of protection. As a result, a low-cost, do-it-yourself method of shore protection is required. The method outlined herein appears to meet the requirements. This system can be installed by owner on a do-it-yourself basis at a cost even less than the contract price for the protection at Frying Pan Bay, summer camp.

Pub. Jan. 64: 15p., NTIS No. AD-440 882: HC \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

15.0005, KENNEDY SPACE CENTER COASTAL EROSION - FLORIDA

A.J. MEHTA, Univ. of Florida, School of Civil Engineering, Gainesville, Florida 32601

Abstract: Dune barrier erosion and possible breaching to storm and hurricane wave activity is being studied at Mosquito Lagoon, in Kennedy Space Center. Results of a geological as well as hydrodynamic study of the problem area indicate that no inlet has existed since 500 A.D., and that there is a

of a possible breakthrough inlet remaining open permanently, primarily because the relatively shallow lagoon does not contain enough volume of water to maintain an inlet between the ocean and the lagoon. It is therefore recommended that only minimal measures, such as closing up the man-made passes across the dunes, be carried out to ensure continuation of the action of natural beach maintaining processes.

Pub. Jun 73: 66p., NTIS No. N73-33337/9: PC \$5.50 MF \$1.45.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

15.0006, BAL. HARBOUR, FLORIDA PARTIAL BEACH RESTORATION, BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT, DADE COUNTY, FLORIDA

UNKNOWN, U.S. Army, Engineer District, *Jacksonville, Florida*

Abstract: An 0.85-mile reach of the Dade County, Florida, Beach Erosion Control and Hurricane Protection Project will be partially restored at Bal Harbour Beach for a protective and recreational beach. Project fill would be obtained from an ocean borrow pit about 1.5 miles offshore in elevations of -36 to -50 feet. About 1.8 million cubic yards of sand will be dredged from an ocean borrow pit and placed along 0.85 mile of beach for restoration of protective and recreational assets. There will be some temporary turbidity and siltation in the borrow and fill areas during construction. Some marine life will be destroyed; however, these populations are expected to become reestablished.

Pub. May 72: 55p., NTIS No. EIS-FL-72-5591-E: PC \$4.75 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

15.0007, Jekyll Island, Georgia, Beach Erosion Control and Hurricane Protection

UNKNOWN, U.S. Army, Engineer District, *Savannah, Georgia* 31402

Abstract: The project proposes restoration and periodic nourishment of 27,000 feet of ocean beach and construction of a 1,000 foot rubblestone terminal groin. Environmental impacts include: Restoration and maintenance of ocean beach, stabilization of eroding shoreline, increased nesting sites for loggerhead sea turtles, enhancement of recreational facilities, improved economic prospects, and continued maintenance of island's aesthetics. Adverse environmental effects include: temporary increased water turbidity and disruption of benthic, plankton and nekton communities during construction; after project completion, probable increased mortality rate of young loggerhead sea turtles.

Pub. Aug. 73: 50p., NTIS No. EIS-GA-73-1315-D: PC \$4.50.

SUPPORTED BY U.S. Dept. of Defense - Army

15.0008, PLANT SPECIES AS WILDLIFE COVER AND EROSION CONTROL ON 'MUDFLATS' IN IOWA'S LARGE RESERVOIR SYSTEMS

J.A. WILSON, Iowa State University, Water Resources Research Inst., *Ames, Iowa* 50010

Abstract: This research project was initiated to examine the natural establishment of plant species in shallow water and on recently exposed mudflats following the annual release of floodwaters in Iowa's large reservoir systems, and determine

vegetated. This esthetically pleasant area has relatively little soil erosion and provides manageable natural areas for man and wildlife. On the other hand, the impact of extreme fluctuations in the water level of the Coralville flood pool is strikingly visible. Dead standing trees, spectral remnants of the original forest, dominate the upper reaches of the flood pool landscape. Mud and debris characterize the area immediately following the recession of floodwaters.

Pub. Jul 73: 78p., NTIS No. PB-226 347/3: PC \$3.75 MF \$1.45

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T.

15.0009, STATEN ISLAND BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT, STATEN ISLAND, NEW YORK

UNKNOWN, U.S. Army, Engineer District, *Watervliet, New York* 12189

Abstract: The report describes the beach erosion control and hurricane protection project consisting of the placement of dune and beach fill, the construction of levees and groins, the realignment of interior streams, and the improvement of interior drainage by use of pumping stations and ponding areas. The project will afford protection against hurricanes and control of beach erosion, resulting in the reduction of the possibility of loss of life, business and property damages, and enhancing the recreational value of the shore. Construction of the project would cause minor interruption of traffic. This condition would cease once the project is completed.

Pub. Sep 72: 11p., NTIS No. EIS-NY-73-0068-D: PC \$3.00.

SUPPORTED BY U.S. Dept. of Defense - Army

15.0010, BEACH EROSION PROJECT, DELAWARE COAST PROTECTION PROJECT, DELAWARE

UNKNOWN, U.S. Army, Engineer District, *Philadelphia, Pennsylvania* 19137

Abstract: The project provides for improvements along the Atlantic Coast of Delaware extending from Cape Henlopen to the Maryland State Line at Fenwick Island. Those improvements include combined beach erosion control and hurricane protection and consists of widening 24.5 miles of beach by placement of suitable sand to provide a berm. In the built-up sections of Rehoboth, Dewey, and Bethany Beaches where dune construction is impractical, approximately 17,700 linear feet of timber bulkheads with stone toes will be constructed. Use of borrow areas and dredging might have negative environmental impact which can be minimized by careful selection of dredging locations and confining the dredging operation to favorable time periods. A temporary increase in turbidity during construction which would have minimum impact on fishery.

Pub. Jun. 71: 21p., NTIS No. PB-199 454-F: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

15.0011, VIRGINIA BEACH, VIRGINIA BEACH EROSION CONTROL AND HURRICANE PROTECTION

UNKNOWN, U.S. Army, Engineer District, *Norfolk, Virginia*

Abstract: A hurricane protection and beach erosion control project is proposed, consisting of sheet pile walls capped with concrete, raising and widening the beach, and recommendation of certain non-structural measures at Virginia Beach.

Preliminary studies have shown that the factors influencing the hydraulic erosion of saturated soils are the amount and type of clay, and the composition of the pore and eroding fluids. The amount and type of clay can be characterized (without destroying the sample) by the magnitude of dielectric dispersion. The compositions of the pore and eroding fluids can be quantified by their conductivities and the sodium adsorption ratio. The shear stress for initiation of erosion can be evaluated by determining the erosion rates that result when various shear stresses are applied to a soil in a rotating-cylinder apparatus. This study seeks a functional relationship among these parameters. The results with several clays will be used to develop soil nomograph for use by agriculturists, engineers, and land-use planners.

SUPPORTED BY U.S. Natl. Science Foundation

15.0013, SAN FRANCISCO BAY

D. MCCULLOCH, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California.

Principal objectives are to provide descriptions of natural processes (geological, seismological, biological, geochemical, hydrographical) to serve as a basis for enlightened use of this major estuary. More specifically, goals are to 1) describe geology, tectonic history, seismic environment and distribution of unconsolidated sediment in the fault-bounded bay basin and on the adjacent continental shelf, 2) describe gross water circulation patterns in the bay and adjacent Pacific as a guide to movement of natural and man-introduced dissolved and solid constituents, 3) describe species composition and aerial distribution of major benthic organism communities, 4) evaluate rates and processes by which trace metals, trace elements and synthetic organic compounds are introduced into the bay, how they are partitioned, and their ultimate fate; includes stream sediment sampling in the drainage basin, analysis of suspended and bottom sediment in the bay and adjacent continental shelf, and analysis of the dissolved phase, 5) establish biological uptake of trace elements, trace metals and synthetic organic compounds by indicator species of benthos, phytoplankton and marine algae, 6) describe distribution of modern bay sediment, the major modes of sediment transport and evaluate rates of deposition and erosion.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

15.0014, SHORT-TERM CLIMATE CHANGES AND COASTAL EROSION, BARROW, ALASKA

J.D. HUME, Arctic Inst. of North America, Washington, District of Columbia 20009

Abstract: Records of shoreline and bluff positions in the vicinity of Barrow, Alaska have been obtained from aerial photographs and tape measurements for intervals between 1948 and 1969. Although the source material in the bluffs is frozen and masses of pure ice are present, temperature and rainfall data fail to show any marked correlation with the retreat of the bluff faces or with the retreat of the fronting or downdrift beaches. Removal of beach material for construction and frequency of storms from the west do show a relationship. Recorded retreats of the bluffs up to 3 m. per year and of the beaches up to 4 m. per year have resulted where there has been excessive beach borrow or where a series of severe storms have attacked the coast.

Pub. 1972: 9p., NTIS No. AD-760 210; Reprint.

Purpose of study/investigation: To procure and develop data on all types of shore improvement structures and methods, and to determine their effectiveness, and to develop criteria or changes in existing criteria applicable to functional and structural design of future structures.

Approach or plan: Data are collected both before, during, and after construction of shore structures, including repeated surveys, material sampling, littoral forces (to extent possible) and that relating to techniques and materials of construction. Data may also be collected from prototype experimental structures in the field, or small scale wave tank studies.

Progress to date: In connection with follow-up studies, data collection and processing were continued at 14 wide-ranging locations involving beaches and related projects. A final report was received from the University of Florida on a cooperative study with the State of Florida to evaluate beach nourishment at Treasure Island, Fla., as well as a preliminary report concerning Key Biscayne and Virginia Key. Data collection on behavior of beach and underwater bottom slopes updrift and downdrift of prototype experimental groin structures (PEG) at Point Mugu, Calif., continued until November 1971, when the panel system was removed. Compilation and analysis of collected data were begun, as was planning for the next test. Preliminary analysis indicated that the structure influenced the shoreline for a distance equal to about three times the groin length. Observation and processing of the program of data collection will continue at this site.

SUPPORTED BY U.S. Dept. of Defense - Army

15.0016, COASTAL ENGINEERING STUDIES RELATIVE TO FLORIDA'S SHORELINE AND BEACH EROSION PROBLEMS

J.A. PURPURA, Univ. of Florida, School of Engineering, Gainesville, Florida 32601

The proposed program represents a long-range investigation to define the causes of and solutions to Florida's shoreline and beach erosion problems. The primary objectives of the study are described in the following paragraphs.

Inlets. - The role of inlets in contributing to the overall shoreline problems will be investigated. Special consideration will be given to the hydrographic features and sand bypassing processes at the various inlets.

Nearshore Sand Resources. - A sub-bottom profile will be used to define nearshore sand resources suitable for beach nourishment purposes.

Susceptibility of General Coastline to Wave Attack. - Wave refraction techniques will be employed to identify areas that are particularly vulnerable to storms originating from various directions. Erosion-deposition occurrences for particular storms will be correlated with these results.

Coastal Construction. - The performances and effects of various types of coastal structures and practices will be assembled and interpreted in order to document the most effective solutions to Florida's coastal problems.

Setback Line. - To make the necessary technical investigations in order to recommend setback lines defining the seaward limit of coastal construction throughout the various coastal counties of Florida.

SUPPORTED BY Florida State Government - Tallahassee

15.0017, A STUDY OF NEARSHORE PROCESSES IN SOUTHEAST FLORIDA

C. EMILIANI, Univ. of Miami, School of Marine Science, Miami, Florida 33149

Objective: The objective is to investigate the interacting influences of the hydrodynamic environment and the sediment-biotic surface on sediment transport and bottom stability in the severely eroding Key Biscayne-Virginia Key Beach and littoral drift zone. This study will combine a general survey of sedimentation, depositional history, and water movement with a detailed examination of vegetative stabilization of the nearshore bottom. The following program is planned for the period November to June, 1972: 1) Determination of past shoreline changes using existing aerial photography and maps. 2) Diving observations and collection of sediment and bottom vegetative samples along sixteen beach-offshore profiles (laboratory analysis of samples). 3) Staking and monitoring erosion-accretion along eight beaches to offshore profiles. 4) Probing and coring in the littoral drift zone to determine character of underlying substrate and recent geologic history. 5) Determination of the wave characteristics in the study area by daily (visual) observations and limited measurements of current intensities and patterns. 6) Procurement, adaptation and in situ testing of an electromagnetic or acoustical bottom current meter.

How information will be applied: The overall results of this project will provide the following management guidelines: 1) How much shoreline protection, bottom stabilization and retardation of sediment loss does a vegetated bottom offer as contrasted with a free sand bottom? 2) What effect would destruction of a certain area of vegetated bottom (by dredging, pollution outwash, sediment starvation erosion) have on the adjacent beach shoreline? 3) What rates of nourishment are necessary to stabilize beaches? What sediment sources should be used? What should be nourished (beach, vegetated bottom)? The results of the first phase of this project will serve as background guidance for the subsequent more detailed phases of the program and will be used to give broader application of these detailed investigations to the area of study.

For additional information pertaining to this project contact Dr. Richard G. Buder, Director, Sea Grant Programs, University of Miami, Coral Gables, Florida 33146

SUPPORTED BY U.S. Dept. of Commerce - NOAA

15.0018, DEPOSITION OF HAWAIIAN WATERSHED AND ESTUARINE SEDIMENTS

P. FAN, Univ. of Hawaii, Water Resources Research Ctr., Honolulu, Hawaii 96822

The main purpose of this study is to determine the erosional rate of watersheds and depositional rate of estuarine sediments, and the pollution effect of estuarine environment by sediment load carried by surface waters. The research plan involves field and laboratory investigation of the watershed and estuarine sediments of Hawaii. Special effort will be concentrated at Waialeale watershed and Pearl Harbor estuary, Hawaii Kai and Maunaloa Bay of Oahu.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Res.

15.0019, NATIONAL SHORELINE STUDY - GREAT LAKES REGION INVENTORY REPORT

UNKNOWN, U.S. Army, North Central Division, Chicago, Ill.

land, water, and land beneath the water in close proximity to the Great Lakes shoreline. They represent a unique resource, rich in aesthetic and ecological values, scenic attractiveness, many beaches and access to the water. These areas provide outstanding recreational opportunities. Shorelands are subject to unique problems of flooding and erosion when subject to unusually high lake levels and storms. The information presented in this report is limited to the U.S. mainline shores of the five Great Lakes. The connecting rivers are excluded. Data on shorelands in the Great Lakes are limited and treated separately.

Pub. Aug. 71: 234p., NTIS No. AD-733 470: PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

15.0020, LAKE SHORE EROSION IN ILLINOIS

W.J. ROBERTS, State Water Survey, Urbana, Illinois

An investigation is being made of shore erosion caused by natural and recreational use. The relationship of bank slope, horsepower, and exposure to headland erosion will be studied. Various protective devices will be suggested and their effectiveness studied.

SUPPORTED BY Illinois State Government - Springfield

15.0021, NATIONAL SHORELINE STUDY - INVENTORY REPORT - LOWER MISSISSIPPI REGION

UNKNOWN, U.S. Army, Engineer District, New Orleans, Louisiana 70160

Abstract: The report is one of the nine regional inventories which are a part of the study and appraisal of the national shoreline authorized by Section 106 of Public Law 483, approved 13 August 1968. It is a compilation of available information on the gulf coast, including bays and rivers, of the State of Louisiana. Included in this inventory report is very general information on the characteristics, nature and extent of erosion, identified problem areas and possible remedial action, ownership, present and future use of the shore.

Pub. Jul. 71: 103p., NTIS No. AD-728 510: PC \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

15.0022, OFFSET COASTAL INLETS - FORMS OF SEDIMENT ACCUMULATION IN THE BEACH AREA, ALASKA, NEW ENGLAND

M.O. HAYES, Univ. of Massachusetts, Coastal Center, Amherst, Massachusetts 01002

Abstract: Offset coastal inlets are common on the New England and the northern Gulf of Alaska. In both areas the dominant waves approach the shore at an oblique angle, resulting in a strong net littoral drift. The most common form of offset on these coasts is a downdrift offset (the downdrift side of the inlet protrudes further seaward than the updrift side). Wave refraction around the ebb-tide inlets is an important process in the formation of downdrift offsets, inasmuch as it creates a local downdrift direction just downdrift of the inlet, and allows sediments to accumulate there. Forms of sediment accumulation in the beach zone include ridge- and runnel systems, berm systems, multiplicity of nearshore bars, cusp-type sand waves (or sand ridges), complex sand bodies affiliated with deltaic and non-deltaic systems of distributaries, and

C.A. KAYE, U.S. Dept. of the Interior, Geological Survey,
Boston, Massachusetts 02203

States to which project pertains: Massachusetts.

The project has studied the erosion of sea cliffs on Martha's Vineyard, particularly Gay Head. The many factors controlling the erosion necessitated an understanding of the geology of the cliffs. This work was extended and in consequence the geology of the island was studied in detail. Field studies are essentially completed. Report writing is the next phase. Vertebrate, invertebrate, and plant fossils collected from the cliffs are being studied by specialists, and it is hoped that final report will include chapters on the paleontology and pre-Pleistocene and Pleistocene geology as well as coastal erosion.

In addition, the project has studied erosion of sea cliffs in Boston Harbor and intertidal rock erosion at Nahant, Massachusetts. Fieldwork is completed except for the making of a detailed plane-table map of the Nahant area.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

15.0024, SIMULATION MODEL FOR STORM CYCLES AND BEACH EROSION ON LAKE MICHIGAN

R.A. DAVIS, Williams College, Graduate School, Williamstown, Massachusetts 01267

Abstract: A mathematical simulation model is used to study the relations among storm cycles, beach erosion, and nearshore bar migration. The model is based on Fourier analysis of weather and wave data collected on Lake Michigan during the summers of 1969 and 1970. In the simulation of coastal processes, barometric pressure is used as the independent variable with longshore current velocity computed as the first derivative and breaker height as a filtered version of the second derivative of barometric pressure. The simulated curves are used to compute wave and longshore current energy for each storm cycle and poststorm recovery.

Pub. Nov. 72: 23p., NTIS No. AD-765 888/3; Reprint.

SUPPORTED BY U.S. Dept. of Defense - Navy

15.0025, PROFILE OF A STORM - WIND, WAVES AND EROSION ON THE SOUTHEASTERN SHORE OF LAKE MICHIGAN

W.T. FOX, Williams College, Graduate School, Williamstown, Massachusetts 01267

Abstract: A large low pressure system that passed through Lake Michigan during late July 1969, provided opportunity for detailed analysis of storm effects on beach and nearshore processes. During the passage of this storm, observations on 17 environmental parameters were being recorded at 2 hour intervals. These data were subjected to Fourier analysis and plotted in a time series by computer. Such analysis shows that there is a definite relationship between barometric pressure, breaker height, breaker angle and longshore current velocity. These are among the significant factors in beach erosion. As the storm passed, the beach and adjacent cliff underwent extensive erosion. The post-storm profile showed a nearshore sand bar which was derived from the beach area during the storm. During succeeding days, this bar began a shoreward migration and was eventually incorporated with the beach.

Pub. 1970: 9p., NTIS No. AD-723 932; Reprint.

SUPPORTED BY U.S. Dept. of Defense - Navy

15.0026, COASTAL ZONE AND SHORELANDS MANAGEMENT - GREAT LAKES

ment and planning techniques and concepts for the Great Lakes which will help to enhance man's use of the areas while preserving a unique and valuable natural system.

How information will be applied: Results of research incorporated in a regional plan being prepared by the City Regional Planning Commission. They will be used by all of the Communities of Grand Traverse Bay. Shorelands Coordinating Committee to solve bay-lands problems and better meet future objectives. Also be presented to the Michigan Water Resource Commission for inclusion in their state-wide shorelands plan and will be further developed and refined throughout the Great Lakes for developing a coastal zone management approach.

Accomplishments during the past twelve months: Provided information to U.S. Corps of Engineers on shoreland management; produced critique of Hawaii's coastal zone; advised local citizens concerning Soil Conservation erosion project; drafted joint publication with Resources Commission; published Traverse Bay Progress Report; helped establish Traverse Bay Coordinating Committee; contributed sections to Bay Regional Planning Commission regional planning conference on shorelands management; advised Bay citizens on marsh preservation; developed comprehensive coastal zone computer system concept; shorelands design concepts and impact matrices; coastal zone library.

For additional information pertaining to this project: John M. Armstrong, Director, Sea Grant Program of Michigan, Ann Arbor, Michigan 48104.

SUPPORTED BY U.S. Dept. of Commerce - N.O.

15.0027, ENVIRONMENTAL, GEOMORPHIC STUDIES OF THE COASTAL REGIMES ALONG THE SOUTH SHORE OF LONG ISLAND - NEW YORK

D.R. COATES, State University of New York, School of Marine and Coastal Sciences, Binghamton, New York 13901

Objectives: The objectives of this project are to evaluate and measure those geomorphic processes that affect the coastal zone and depositional sedimentation regimes of the beach environment on the South Shore of Long Island.

How information will be applied: Despite enormous expenditures by Federal and State agencies on erosion control on the South Shore of Long Island, there has been little attention given to providing information of use to local management and to the development of alternative procedures to those of Federal orthodoxy. Among the agencies seeking information from this project are: Fire Island Regional Sensory Commission, Nassau-Suffolk Planning Board, the New York State Park Commission, Town governments. Citizens conservation and environmental groups also seek the information. Through close cooperation with these groups and through the Sea Grant Advisory Program an educational program will be established above agencies and among the citizens as a group.

Accomplishments during the past twelve months: 1. A dune stabilization problem on Fire Island. 2. Oceanographic nature of man-made alterations on bay side of Fire Island such as boat slips, marinas, dredging. 3. Evaluation of causes that contribute to abnormal accelerated erosion in certain parts of Fire Island. 4. Studied factors that control limits for utilization of Fire Island region.

resource. 5. Measured quantitative shoreline changes of Fire Island for the period 1962-1972. 6. Initiated a program for wave hindcasting of the South Shore. 7. Identified areas of potential washovers or breakthroughs on Fire Island. 8. Initiated a study of the relationship of dune height and profile to shore recession.

For additional information pertaining to this project contact Dr. Donald F. Squires, Director, New York State Sea Grant Program, State University of New York, Albany, New York 12210.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

15.0028, GROIN STUDY ON THE NORTH SHORE OF SUFFOLK COUNTY, LONG ISLAND, NEW YORK, BETWEEN ORIENT POINT AND PORT JEFFERSON HARBOR

T. OMHOLT, New York Ocean Science Lab., Montauk, New York 11954

Approximately fifty small groins located on the north shore of Suffolk County will be evaluated for their effectiveness in trapping sand and their effects on adjacent beaches. Changes in the shoreline will be investigated by the use of existing maps, charts and aerial photographs, beach surveying and wave refraction techniques.

SUPPORTED BY New York Ocean Sci. Lab. - Montauk, N.Y.

15.0029, EROSION AND DEPOSITION IN THE SOUNDS AND ESTUARIES OF THE NORTH CAROLINA COAST

R.L. INGRAM, Univ. of North Carolina, School of Arts, Chapel Hill, North Carolina 27514

The objectives of this project are: (1) to determine the changes that are taking place in the bottom topography and shorelines of selected study areas typical of the total sound-estuary environment of the North Carolina coast, but especially Pamlico Sound, (2) to study the erosional and depositional processes responsible for these changes; and (3) to predict future changes.

How information will be applied: Information gained in this program will be used by State and Federal agencies to predict the effects on erosion and deposition of (1) storms; (2) changes in river regime from floods, droughts, dams; (3) soil conservation practices; (4) opening and closing of inlets; (5) dredging activities; (6) construction of shoreline facilities; (7) shoreline and bottom mining.

Accomplishments during the past twelve months: old and new aerial photographs of the study areas have been obtained and are being studied. Detailed Fathometer tracings are being made. The heavy mineral content of 173 samples has been used to estimate the source of the sands being deposited in the sounds and estuaries. The clay mineral content of 80 samples has been used to estimate the source of the clays being deposited in the sounds and estuaries. Box cores are being taken in the study areas.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

15.0030, SHORE EROSION STUDY OF ERIE COUNTY, OHIO

L.L. BRAIDECH, State Div. of Geolog. Survey, Columbus, Ohio 43212

The objective of this project is to obtain data for an up-to-date appraisal of the geology of the shoreline and nearshore bottom

Field work will include: reestablishment of a horizontal vertical control system, preparation of map showing location of the present shoreline and land features, graphic survey of the study area, collection and mapping of bluff, beach, and nearshore bottom material, borings to bedrock, study of wind and weather patterns, study of variations in lake level, measurement of currents, a study of ice conditions, investigation of sedimentology, comparison of repetitive aerial photographs, determination of rates of shore erosion and bluff recession, study of dune formation and movement, littoral processes, and existing structures.

SUPPORTED BY Ohio State Government - Columbus

15.0031, SHORE EROSION STUDY OF LAKE ERIE, OHIO

L.L. BRAIDECH, State Div. of Geolog. Survey, Columbus, Ohio 43212

The objective of this project is to collect data for a study of the geology of the shoreline and nearshore for that portion of Lake Erie located within the limits of Lake County. A study and mapping of the shoreline of Lake County. A study and mapping of the shoreline along the shoreline will extend landward far enough so that portion of the land mass most directly affected by problems of shore erosion. This distance may vary from area to area but will not extend further landward than the unaffected roadway paralleling the shoreline.

This area undergoes the most severe annual erosion and will therefore receive the primary focus of attention in an over-all erosion control study for the entire shoreline of Lake Erie. Field work will include: the measurement and sampling of sections of the bluff and slopes, run profiles and sampling for mechanical and mineral analysis, boring and probing to bedrock, study of current patterns, determination of volumes of bottom material transport by use of sediment collector platforms, estimation of erosion losses by use of aerial photography.

Baseline control and shore point locations established by the Beach Erosion Control Board, U.S. Corps of Engineers will be utilized for this study.

SUPPORTED BY Ohio State Government - Columbus

15.0032, SHORE EROSION STUDIES ALONG THE SHORE OF LAKE ERIE

C.H. CARTER, State Div. of Geolog. Survey, Sandusky, Ohio 44870

Our studies will document the what, where, how, and rates of shore erosion along the Ohio shore of Lake Erie. We are particularly interested in looking at the effects of man-made structures on the shore processes.

Aside from basic mapping techniques we have established points to measure erosion and/or accretion rates from the shore to 2000 feet offshore. Aerial photography as early as 1930 has enabled us to observe changes in the shoreline zone within a precise chronologic framework.

We hope to have five counties (Lake, Erie, Sandusky, Seneca, and Lucas) completed by the spring of 1974 and the remaining three counties (Ashtabula, Cuyahoga, and Geauga) completed by late 1974.

SUPPORTED BY Ohio State Government - Columbus

15.0033, EVALUATION OF GEOLOGIC AND

for the configuration of the coast. The inaccessible parts of the coastline (about 14%) will be examined from the air.

Refraction diagrams for different wave conditions will be prepared in order to evaluate the distribution of wave energy along selected portions of the coast.

The relative importance of the geologic and oceanographic factors will be determined, areas particularly prone to erosion delineated, and the results of the evaluation made public and submitted to the Advisory Committee to the State Land Board.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Res.

15.0034. EROSION AND SEDIMENTATION FOLLOWING ROAD CONSTRUCTION AND TIMBER HARVEST ON UNSTABLE SOILS IN THREE SMALL WESTERN OREGON WATERSHEDS

R.L. FREDRIKSEN, U.S. Dept. of Agriculture, Pac. N.W. For. & Rg. Exp. Sta., Portland, Oregon 97208

Abstract: In two steep headwater drainages, landslides were the predominant source of increased sedimentation of streams following timber harvest. Patch-cut logging with forest roads increased sedimentation compared with a control by more than 100 times over a 9-year period. Landslide erosion was greatest where roads crossed high gradient stream channels. In an adjacent clearcut watershed with no roads, sedimentation increased three times that of the control.

Pub. 1970: 19p., NTIS No. PB-194 987: MF \$0.65.

SUPPORTED BY U.S. Dept. of Agriculture

15.0035. PROPERTIES AND STABILITY OF A TEXAS BARRIER BEACH INLET

C. MASON, Texas A & M University System, Graduate School, College Station, Texas 77843

Abstract: An environmental study was conducted at Brown Cedar Cut, a natural unstable barrier beach inlet connecting East Matagorda Bay, Tex., with the Gulf of Mexico. The objectives of this study were to determine the physical and hydraulic properties of the inlet, and to investigate the inlet's historical stability, as well as its short-term response to a number of physical processes. Results of the study indicate that hurricanes and continuing erosion of adjacent beaches enhance the long-term stability of the inlet. During winter months, the rapid passage of strong frontal systems and associated winds, as well as substantial amounts of rainfall, are primarily responsible for the day-to-day variability of the channel boundaries. In the absence of such forces, the predominance of littoral drift over the limited flushing ability of astronomical tidal currents leads to degradation of the inlet channel and westward migration of the entire inlet system.

Pub. Aug 71: 175p., NTIS No. COM-71-01019: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Science Foundation

15.0036. INVESTIGATION OF SHORELINE CHANGES AT SARGENT BEACH, TEXAS

W.N. SEELIG, Texas A & M University System, Graduate School, College Station, Texas 77843

Abstract: An environmental study was conducted at Sargent Beach, Texas, an erosive beach bordering the Gulf of Mex-

ate since at least 1930 with recent shoreline recession averaging 30 feet per year. Storms are the primary cause of erosion that remove material from the beach, while lost sands are not replaced because Brazos River sands normally expected to move alongshore are trapped in the Brazos. Hurricanes may free stored deltaic sands carrying quantities offshore from beach areas. Beach erosion is aggravated by decreased sand input to the coast by the Brazos River due to alterations to the river and its basin in the 1940's.

Pub. Sep. 73: 162p., NTIS No. COM-74-10157/1: 1 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.

15.0037. TEXAS BARRIER ISLANDS

R.E. HUNTER, U.S. Dept. of the Interior, Geological Survey, Corpus Christi, Texas 78411

States to which project pertains: Texas.

The project is a topical study of coastal sediments and sedimentary processes on and adjacent to the barrier islands of the Texas Gulf Coast. The ultimate objectives are: (1) to determine the conditions and processes responsible for the growth, and maintenance of barrier islands, (2) to determine where and where excessive coastal erosion and sedimentation occur, and (3) to develop criteria for the recognition of barrier islands and nearshore deposits in ancient sedimentary rocks. These goals will be pursued through the investigation of objectives of defining the kinds and rates of sedimentary processes and the character of the resultant depositional landforms.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

15.0038. ENVIRONMENTAL GEOLOGY OF SEVERAL PARTS OF NORTHWESTERN VERMONT

W.P. WAGNER, Univ. of Vermont, State Resource Center, Burlington, Vermont 05401

The objectives of the proposed project are: (1) to evaluate the water supply potential of the Champlain Valley, by mapping aquifers, water table elevations, recharge and discharge capacities; (2) to locate and evaluate suitable sites for garbage dumps in the Champlain Valley; (3) to evaluate the septic waste disposal potentials of selected upland areas; (4) to map the distributions and evaluating the character of unconsolidated materials; (5) to evaluate the magnitude, and extent (rates) of stream bank and channel erosion.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Res.

15.0039. SEDIMENT MOVEMENT AND HILLSLOPE MORPHOLOGY IN THE CENTRAL APPALACHIAN MOUNTAINS - VIRGINIA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Arlington, Virginia 22209

Sediment, particularly in connection with major rainfall events, causes many deaths and millions of dollars damage annually. The destruction results from sediment erosion, its movement down hillsides and along stream channels, and its deposition. The prediction of important sediment-related events and the prevention or reduction of damage cannot be possible until systematic, planned sedimentological and geomorphic studies are made.

To derive a basis for predicting the occurrence and nature of major sediment movements on hillslopes and in channels in the Central Appalachians and nearby areas, in order to prevent or reduce the customary widespread damage that occurs to man and his property from such movements.

Document and examine the geomorphic and sedimentologic features of catastrophic sediment movements such as those which resulted in central Virginia from the rains of hurricane Camille in 1969. Measure and evaluate the extent and location of erosion, the amount and location of deposition, sizes of sediment particles involved, geomorphic characteristics of affected and unaffected hillslopes and valleys, and any other features which may aid in attaining the research objective.

Obtain further field data on channel geometry and bed-material samples. Continue analyzing data on channel geometry. Write further portions of first draft of manuscript on same. Results to date show some promise of establishing a relationship between flow characteristics at a station and certain measurable features of the channel, such as shape of cross-section and sizes of bed material.

Complete the analysis of the data on hand; obtain additional data as the need arises; draw conclusions; finish writing first draft of manuscript.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

16. MULTIPLE HAZARDS

INDIVIDUAL ASSISTANCE

16.0001, EMERGENCY OPERATIONS SYSTEMS DEVELOPMENT - CIVIL DEFENSE RESCUE PHASE II

L.C. THOMAS, Stanford Research Institute, Menlo Park, California 94025

Abstract: The major purpose of the Phase II rescue task was to redefine the rescue function in terms of a broad lifesaving role so that the bases for guidance materials for local governments would be fully supported by these findings. The report deals with the attack environment, base for rescue, operations, supporting services, program elements, and rescue force acquisition.

Pub. Nov. 67: 111p., NTIS No. AD-776 350/1: PC \$8.75 MF \$1.45.

SUPPORTED BY No Formal Support Reported

16.0002, CONSULTATIVE PSYCHIATRIC SERVICES TO INDIVIDUALS AND COMMUNITY GROUPS AND AGENCIES IN RAPID CITY, SOUTH DAKOTA

C.L. KEENER, Unknown Inst. or Indiv. Grant, Colorado (HSM-42-73-58)

The Contractor shall furnish all necessary services and materials to provide consultative psychiatric services to individuals, community groups and agencies in the Rapid City, South Dakota area regarding disaster related mental health problems. Specifically, the Contractor shall: 1. Provide consultation in symptoms of disaster related mental health problems and ways to handle them. 2. Provide individual care consultation with mental health workers and physicians. 3. Provide consultation with community agency and group members as to handling their own feelings and reactions as a result of working with flood victims. 4. Assist in the develop-

residents of possible emotional reactions and ways to cope with them. 6. Provide residents an opportunity to express their concern and reactions or possible reactions to the disaster.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - ILS.M.H.A

16.0003, DEVELOPMENT OF TRAINING PROGRAM FOR EMERGENCY MEDICAL SERVICE PROGRAM ADMINISTRATION

UNKNOWN, Dunlap & Associates Inc., Darien, Connecticut 06821 (045526)(TRAIS)

A training program for Emergency Medical Services (EMS) will be developed to fulfill the requirements of Highway Safety Program Standard No. 11 with respect to program administration of state and local emergency medical services. A detailed project schedule will be developed, as well as a complete knowledge, skill, and behavioral specification for EMS program administration, including the terminal, instrumental, and associated performance requirements. The training objectives will be determined, and curriculum content and methodology developed. The curriculum will be organized to reflect the logic and sequence of the training program.

Document provided to S.S.I.E. by the T.R.A.I.S.

SUPPORTED BY U.S. Dept. of Transportation - N.H.T.S.A.

16.0004, PROBING THE LAW AND BEYOND - A QUEST FOR PUBLIC PROTECTION FROM HAZARDOUS PRODUCT CATASTROPHES

J.M. BROWN, George Washington University, Prog. of Pol. Stud. Sci. Tech., Washington, District of Columbia 20037

Abstract: Contents: Progress and the calculated risk; The legal process as a response mechanism; Interaction of the legal process with institutional response mechanisms; Institutional mechanisms responsive to disaster; The Ohio State University Disaster Research Center; Identification of representative elements of a tolerable risk; Phase lines of community involvement in disaster situations; Recent Federal Government hazard-related activities.

Pub. Jul. 69: 62p., NTIS No. PB-192 558; HC \$3.00 MF \$0.65.

SUPPORTED BY No Formal Support Reported

16.0005, THE FEDERAL RESPONSE TO TROPICAL STORM AGNES; A REPORT TO THE SENATE COMMITTEE ON PUBLIC WORKS, SUBCOMMITTEE ON DISASTER RELIEF

UNKNOWN, U.S. Exec. Office of the Pres., Off. of Emergency Preparedness, Washington, District of Columbia 20006

This report covers the activities of the Office of Emergency Preparedness and other Federal agencies in the seven States that were declared major disaster areas as a result of Hurricane Agnes and the ensuing tropical storm. By bringing together in one report the activities of several agencies, the report highlights the coordination that was achieved among local, State, Federal, and voluntary agencies in restoring community services and aiding individuals to recover from the effects of this disaster.

Pub. May 73: 62p., Fed. Disaster Assist. Admin., Dept. of HUD, Wash., D.C.

Abstract provided by FDAA.

H.E. SATALLEY, Georgia Institute of Technology, Atlanta Systems Research Center, Atlanta, Georgia 30332

The objective of this project is to develop an emergency medical system (EMS) simulation model to be used in the planning of emergency medical services. The model is to be able to evaluate the effects on emergency medical services of changes in the following EMS factors: communications, emergency dispatching procedures, emergency vehicle routes; the number, location, and types of emergency facilities; treatment at the scene, enroute, and within the emergency facilities, number, types, and location of emergency vehicles, emergency vehicles equipment; and training of emergency vehicle attendants.

The planning model is to have the capability to evaluate changes in the EMS factors in terms of appropriate measures of effectiveness such as emergency system response time, emergency victims mortality rates, and the percentage utilization of emergency system components. Also, the incidence of long delays before the arrival of an emergency vehicle is to be incorporated in the model as a measure of effectiveness. The EMS planning model may be used by health planners who must determine how best to change an emergency medical system to respond to the expanding demands for emergency services or to improve the performance of an emergency medical system.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - H.S.M.H.A

16.0007, MILITARY BLOOD BANKING (CIVIL DISASTERS)

F.R. CAMP, U.S. Army, Medical Research Laboratory, Fort Knox, Kentucky

Abstract: The article presents factors that feature predominantly in providing safe blood therapy in a civil disaster situation. Equally important are the special problems existing today which are discussed because they can cause injury to the recipient of blood transfusion. The Blood Transfusion Officer must make the decision to shift from business-as-usual to an emergency set of procedures. The spring team chief should be in a position to know the number of casualties the hospital can accommodate and this information should be available to the professional staff and blood bank. This variable is influenced by the size of the medical installation. Even with training and experience, these are difficult decisions. Practice runs in all areas responsible for handling mass casualties are strongly recommended for the blood bank and hospital staff.

Pub. May 71: 15p., NTIS No. AD-726 341; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0008, BODY RECOVERY DOG

W.L. QUINN, U.S. Army, Land Warfare Laboratory, Aberdeen Proving Ground, Maryland 21005

Abstract: A four-month study that demonstrated the feasibility of training dogs to search for and locate human casualties under conditions that might exist in the aftermath of man-made or natural disasters was conducted as a joint project by the U.S. Army Land Warfare Laboratory and the U.S. Army Infantry School. Four body recovery teams, each consisting of a dog and its handler, were trained to search in mud, water, rubble of demolished buildings, wrecked vehicles, and in sanitary fills and dumps for simulated human casualties. The teams are available for employment by civilian as well as by military authorities in the event of a disaster.

Pub. May 73: 49p., NTIS No. AD-763 219; PC \$3.00 MF \$0.95.

P. VILLONE, U.S. Natl. Aero. & Space Adm., Goddard Space Flight Center, Greenbelt, Maryland 20770 (036214)

Solve the acute problem facing Search and Rescue (SAR) agencies in minimizing the time interval between the occurrence of a mishap and the initiation of rescue efforts.

Document provided to S.S.I.E. by the T.R.A.I.S.

SUPPORTED BY U.S. Dept. of Transportation - Coast Guard

16.0010, SEARCH AND RESCUE COMMUNICATIONS. GLOBAL RESCUE ALARM NET (GRAN)

W.R. CRAWFORD, U.S. Navy, Air Test Center, Patuxent River, Maryland 20670

Determine the feasibility of using satellites to receive and relay low power distress signals to provide world-wide search and rescue capability.

Conduct tests utilizing low power radios (250-600 mw) to access present satellites. Determine ability of satellites to receive and translate the low power signal. Omega retransmission techniques being developed to provide precise localization of personnel in distress. Omega signals analyzed at monitoring ground station.

Supporting agency address information: Naval Air Systems Command AIR 340F, Washington, D.C. 20360

SUPPORTED BY U.S. Dept. of Defense - Navy

16.0011, PUBLIC HEALTH SERVICE, DISASTER ASSISTANCE REPORT JULY 1967-JUNE 1970

UNKNOWN, U.S. Dept. of Hlth. Ed. & Wel., P.H.S. Hlth. Serv. & M.H. Adm., Rockville, Maryland 20852

This report covers assistance provided by the U.S. Public Health Service (PHS) during 79 disasters that occurred in the United States from July 1, 1967 through June 30, 1970. It is a consolidated report based on daily statements that were issued from Department of Health, Education, and Welfare Regional Offices by Emergency Health Services Program Directors who are responsible for coordinating all PHS disaster activities. It is possible that some disaster assistance and relief activities were not reported to the PHS coordinating offices and therefore not sent in headquarters in Washington, D.C. Thus, they would not appear in this report. Also included is material that outlines PHS assistance of States and several foreign countries during disease outbreaks, epidemics, and threatened epidemics.

In this report there were 26 disasters of sufficient magnitude that the President of the United States declared them major disasters, making the States in which they occurred eligible for financial and other assistance provided by the Federal Disaster Act (PL 875). This Act, administered by the President's Office of Emergency Preparedness (OEP), enables States and local governments to receive supplemental Federal assistance that includes money, medicines and other consumable supplies, protective and other services to help preserve life, and emergency repairs to damaged or destroyed public facilities.

Pub. April 1971: 54pp., Public Health Service Publication 1071-A-12, Emergency Health Series A-12.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - H.S.M.H.A

16.0012, HELICOPTER AMBULANCE SERVICE TO EMERGENCIES

Abstract: The study concludes that helicopter ambulance service would be reasonable in the outlying areas of the state because: Ground ambulance service with adequately trained personnel is not readily available in the remote areas of the state; Medical facilities are not as numerous and do not have the capabilities of caring for the critically injured. This necessitates transferring the patient to a larger medical facility in a metropolitan area; Transfers of the critically injured from outlying hospitals to a metropolitan area via helicopter with its greater speed and smoother ride would be the greatest service a helicopter could offer.

Pub. Mar. 71: 161p., NTIS No. PB-200 308; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

16.0013, COORDINATED ACCIDENT RESCUE ENDEAVOR, STATE OF MISSISSIPPI (PROJECT CARE-SOM) - VOLUME I - OPERATION STRUCTURE AND PROCEDURES

J.E. CLARK, Mississippi St. University, School of Engineering, State College, Mississippi 39762

Abstract: Project CARE-SOM was a 15-month study of a total emergency medical service system. The concept of the total system which involved the application of new techniques and existing technology was developed by the authors who are engineers and researchers. Advice and the services of experts and personnel in the fields of law, medicine, communications, and law enforcement were obtained through an advisory committee. The system was operated by local people who were a part of the existing emergency medical services including physicians, hospital personnel, ambulance attendants, and law enforcement officers. The cooperation of these people was essential if meaningful results were to be obtained. The performance of the system was recorded through a data collection program and measured by the Project research staff at Mississippi State University. Certain aspects of the system were stimulated by a mathematical model using field data as input.

Pub. Sep. 70: 184p., NTIS No. PB-199 756; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

16.0014, CONSOLIDATED SYSTEMS OF EMERGENCY SERVICES - NEBRASKA (PROJECT 20/20)

D.G. PENTERMAN, State Off. of the Adj. Gen., Lincoln, Nebraska

Abstract: The purpose of the demonstration project was to develop a flexible, comprehensive methodology for evaluating and improving emergency medical service systems on the highways of the State of Nebraska, and implement a total system concept which would demonstrate the maximum use of multidisciplinary subsystem for rapid and effective response to the urgent needs of highway sick and injured, and to establish an emergency notification, dispatch, and assistance program for highway accident victims. The research program consisted of eight elements for detailed study. They were: notifications, video tape documentation; ambulance attendant and training; one county road equipment test; computer assist information system; comparative analysis of air and ground ambulances; vital function telemetry; and

16.0015, DEVELOPMENT OF A DISTRESS AND LOCATING SYSTEM (DALS) FOR SEARCH AND RESCUE MISSION

UNKNOWN, Benkers Laboratories Inc., Smithtown, NY 11787 (025086)

Development of a distress alerting and locating system for search and rescue mission. This system will combine an alpha-numeric identification and a redundant capability into a Benkers Locate Mode Track and Position System. The alpha-numeric redundant capability, i.e. CG-30.515, was developed by Electronics Benkers Laboratories will modify the track and position equipment to incorporate this

Document provided to S.S.I.E. by the T.R.A.I.S.

SUPPORTED BY U.S. Dept. of Transportation -

16.0016, ANALYSIS OF EMERGENCY MEDICAL SERVICES COLUMBUS AND ALL FRANKLIN COUNTY POLITICAL SUBDIVISIONS

R.C. CHASE, Ohio State University, School of Medicine, Columbus, Ohio 43212

Information of the emergency medical services throughout Franklin County during a four month study will be gathered to field test an existing HEW system model of emergency medical service. The study will be used to develop recommendations and evaluate the feasibility of developing a program which can be applied to other cities in Ohio.

SUPPORTED BY Ohio State Government - Columbus

16.0017, THE SALVATION ARMY - ITS STRUCTURE, OPERATIONS, AND PROBLEMS IN DISASTER RELIEF

J.L. ROSS, Ohio State University, Disaster Research Center, Columbus, Ohio 43210

Abstract: The history and organizational structure of the Salvation Army are discussed with attention directed to the religious and social welfare orientations of the organization. The report focuses on disaster relief operations, the general conditions influencing the participation of the Salvation Army in contemporary major community emergencies in America. Included in the report is an illustration of operations the Salvation Army engages in, in the wake of a large-scale hurricane. The implications for Salvation Army operations in a nuclear environment are also presented.

Pub. Dec. 69: 68p., NTIS No. AD-709 676; HC \$0.65.

SUPPORTED BY No Formal Support Reported

16.0018, SYSTEMS ANALYSIS OF EMERGENCY MEDICAL DELIVERY

W.F. HAMILTON, Univ. of Pennsylvania, School of Medicine, Philadelphia, Pennsylvania 19104

Planning for emergency services has typically been fragmented and inadequate. Emergency care in most communities depends upon a fragmented collection of transportation, communication, hospital, and physician services. Description of an emergency medical care system is assuming an increasingly important role in the delivery of personal health care. The emergency room has replaced the vanishing family physician in many areas and is now the primary medical care for certain patient groups.

operation and medical services. Specific aims of the proposed research include the development, application, and evaluation of a simulation model of the emergency care system. Past descriptive studies and modeling efforts have generated a suitable data base for the proposed research.

The research plan is to: (1) conduct an extensive information search into previous descriptive and normative studies of emergency care systems; (2) to develop a realistic model of emergency medical care delivery and validate the model using available data with Philadelphia as the test site; (3) to use the model to analyze possible improvements in emergency care organization and delivery; (4) to evaluate and document the findings; and (5) to develop a long term research program for extending the methodology to planning for the delivery of other outpatient services.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - H.S.M.H.A

16.0019, RECOVERY FROM NATURAL DISASTERS - INSURANCE OR FEDERAL AID

UNKNOWN, Univ. of Pennsylvania, School of Commerce, Philadelphia, Pennsylvania 19104

A case for a system of disaster insurance to replace the current federally subsidized disaster relief policy. In the last twenty years, as the cost of repairing damage from natural disasters has come increasingly to be treated as a public responsibility, federal disaster aid has risen from \$52 million (fiscal 1953) to over \$2.5 billion (fiscal 1973). Professor Kunreuther shows that the current disaster relief program has failed to discourage individuals from locating in hazard-prone areas and may, in fact, reinforce their reluctance to insure themselves against potential losses.

How would the disaster victim and the federal government fare if an insurance program were to replace the present SBA disaster program? Professor Kunreuther provides a quantitative answer to this question through a detailed analysis of Small Business Administration disaster loan files covering the San Fernando Valley earthquake (1971), the Rapid City flood (1972) and Tropical Storm Agnes (1972). He finds that, on the average, disaster insurance is preferable to federal disaster relief from the point of view both of the homeowner and of the federal government.

Pub. Dec. 73: 71p., Eval. Studies 12 Dec. 73, ISBN0-8447-3122-6; Amer. Enterprise Inst. for Pub. Policy Res. Wash., D.C., PC \$3.00.

Abstract provided by FDAA.

SUPPORTED BY No Formal Support Reported

16.0020, TRAINING PROGRAM FOR CRISIS INTERVENORS

UNKNOWN, Western Health Systems Inc., Rapid City, South Dakota 57701 (HSM-42-74-17(OD))

The Contractor shall, through its Committee of Mental Health, plan, develop and implement a Mental Health Training Program for Crisis Intervenor (also referred to as 'Natural Helpers' and 'Trainees') to deliver services to the people of the Sixth Planning and Development District of South Dakota affected by the flood of June 9, 1972 and to provide for an evaluation of the training and the trainee's practicum relevant to the delivery of mental health services.

The Contractor will search for, find and train within the community 'natural helpers' (crisis intervenors) who will reach out and identify those with mental health problems, discover causes and facilitate their resolution.

and improvement of the troubled individual's emotional and the organization of groups (or use of existing groups) with community problem areas that contribute to stressors. The 'natural helpers' (crisis intervenors) will provide treatment for those clients with emotional problems but will be trained in their detection and refer to appropriate professional mental health specialists for treatment.

The training program will train and assist the trainees in the implementation of the 'Searchlight' model in their work setting. The professional trainees will be assisted by FUND in developing concepts and skills in: a) descriptions, b) reflections, c) natural management of neighborhoods, neighboring patterns and mutual identification of additional staff and d) conceptualization of trainee relationships and the relationship of the trainees to the community.

In-service training will be provided by Lutheran Social Service Staff throughout the year of the Project to assist the trainee's skills in communication. The training will be provided in group sessions with one or two trainers to cover listening, problem solving and small group organization.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - A.D.M.H.A

16.0021, MANAGEMENT OF INSURABLE RISK

M.B. BADENHOP, Univ. of Tennessee, Agricultural Experiment Sta., Knoxville, Tennessee 37916 (TENN0021)

Objective: Determine the extent and effectiveness of crop insurance; determine the extent of risk owned by Tennessee farmers, the insurable risk, the values exposed, and the risk management strategies employed; and appraise risk management programs employed with reference to values exposed, the insurance coverage, their cost and indemnities paid.

Approach: Data from records available with the Federal Crop Insurance Corporation will be used to select counties with homogenous risk in crop production. Randomly selected counties will then be selected and a random sample of farmers drawn from each county and interviewed for information on crop insurance programs. These interviews will also supply data on capital values owned, insurable risk, risk management strategies employed. Indicators of risk management within developed risk classification systems will be established with reference to values exposed to risk, insurance coverage, effectiveness of risk strategies, and loss probabilities. Model risk management systems will be constructed and resolved through linear programming and minimization procedures. Comparisons will be made between types of insurance. Guidelines to assist farmers in making sound risk management decisions will be prepared.

Progress: One hundred sixty East Tennessee farm families were interviewed for information on risk circumstances and insurance coverage used to protect values at risk. From these data, a summary of overall insurance management effectiveness was prepared. The quantitative variables used were the value of crop, insurance coverages, and financial reserves. Insurance coverages averaged \$257 per farmer in 1969 to cover values at risk—mostly their physical assets worth \$22,000 per farmer. These farmers, however, allocated only 15% of their insurance budget to protect their physical assets about 30% of their replacement value. Other budget allocations were: 8% to cover possible loss from the tobacco crop; 24% for automobile insurance; 14% for hospitalization insurance; 14% for life insurance.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

SUPPORTED BY Texas A. & M. University System

16.0022, EVALUATION OF POLICY-RELATED RESEARCH IN THE FIELD OF MUNICIPAL SYSTEMS, OPERATIONS, AND SERVICES - EMERGENCY MEDICAL SERVICES**H. PLAAS**, Univ. of Tennessee, School of Liberal Arts, Knoxville, Tennessee 37916

The purpose of this study is to review the research in Municipal Emergency Health Care Services (EHCS) and to systematically evaluate the usefulness of the research for municipal policy making.

Currently EHCS is once again being recognized as a vital part of the health care system. In the process, traditional concepts of organization and administration are being challenged as inappropriate for the conditions now current in urban and rural America. Municipal governments and urban communities are particularly being challenged to reconsider their place in the provision of emergency health care services.

The purposes of this study are: (1) to assemble and classify research in EHCS; (2) to propose a conceptual framework for EHCS which will be useful for doing the following: a) evaluate the validity of various pieces of research from the perspective of the adequacy of research design and methodology; b) to evaluate the contribution of the research to total systems gains and to evaluate its credibility in the light of other studies; and c) to determine the policy relevance of the research, including impact on patient recovery, system acceptable costs and to test the policy utilization resulting from the studies.

SUPPORTED BY U.S. Natl. Science Foundation

16.0023, DESIGN TO ESTABLISH A FEASIBLE PLAN FOR EMERGENCY MEDICAL CARE, IN THE METROPOLITAN NASHVILLE-MIDDLE TENNESSEE REGION**C.E. GOSHEN**, Urban Obs. of Met. Nashville, Nashville, Tennessee

Abstract: The need is shown for coordination and integration of existing health-care facilities to increase efficiency and allow geographical expansion of emergency medical services. The proposed design describes both available and needed software (system design charts, personnel) and hardware (air and ground vehicles, data and communication systems) in three major areas: hospital-medical services, communication, information, and ambulance/on-site services. Links are needed with other agencies (police, fire) for coordination and supplemental information (e.g. traffic, mud and weather status). The recommended plan has been implemented and is now operational in middle Tennessee.

Pub. Jan. 70: 20p., NTIS No. PB-230 959/PC \$4.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0024, THE ROLE OF HELICOPTERS IN EMERGENCY MEDICAL CARE SYSTEMS**D.P. SKOGMAN**, Texas A & M University System, School of Engineering, College Station, Texas 77843

Abstract: The major purpose of this paper is to contribute toward improved emergency medical care. The results of helicopter performance in civilian air rescue operations are presented. Suggestions as to the future role of helicopters in emergency medical care are given. The other

PUBLIC ASSISTANCE**16.0025, URBAN GEOLOGY - PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, AND COSTS OF GEOLOGIC HAZARDS AND RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)****UNKNOWN**, State Div. of Mines & Geology, Sacramento, California 95814

The results of a three-year study of geologic problems in California are presented. The total projected loss attributable to property damage, life loss and loss of mineral resources, including both direct and indirect costs, caused by ten geologic problems in California from 1970 to 2000 is estimated to be \$55 billion. Four problems - earthquake shaking, loss of mineral resources, landsliding, and flooding - account for 98 percent of the total projected loss. The remaining 2 percent of the estimated loss is due to erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence.

The state of the art relative to measures to reduce losses caused by the ten geologic problems is reviewed and benefit-cost ratios are presented for each problem. An estimated \$38 billion of the \$55 billion total projected loss could be prevented by application of current state-of-the-art loss-reduction measures. The total cost of applying these measures is estimated at \$6 billion, for an overall benefit-cost ratio of 6.2:1. In addition, then, to satisfying the needs for increased public safety and the social and political concerns therefore, geologic hazards loss-reduction is also 'good business'.

The degree of effectiveness of the various types of loss-reduction measures possible are reviewed and recommendations are presented. The most effective action that can be taken is for cities and counties to strengthen and diligently enforce existing grading ordinances and building codes.

A methodology for setting priorities for the application of loss-reduction measures is presented. The study concludes that no single ranking of priorities with respect to localities, specific problems, or particular loss-reduction programs, is feasible; but the actions taken should commence in the more populated and the more hazardous areas.

Pub. 73: 112p., No copy info available.

Abstract provided by FDAA

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0026, DEBRIS CLEARING TIMES AFFECTING CRITICAL SURVIVAL ACTIONS**T.N. WILLIAMSON**, Jacobs Associates, San Francisco, California 94111

Abstract: Clearing of emergency rescue routes through street debris would be a most urgent operation following a nuclear attack or other massive debris-causing event. Paths at least wide enough to pass ambulances, rescue vehicles and fire trucks will be required where there may be survivors or facilities which must be protected for survivors. This study analyzes the debris potential in 24 residential situations ranging from single family units to multi-story apartments, all subject to 2.4, 6 and 10 psi overpressures. The effectiveness of debris clearing operations is discussed.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0027, IMPROVISING ELECTRIC POWER FROM INDUCTION GENERATORS DURING PROLONGED POWER OUTAGES

R.H. BLACK, U R S Systems Corporation, San Mateo, California 94402

Abstract: The objective of the work is to: Determine the feasibility of using large induction motors as induction generators; Work out the problems attendant with using engine generators and induction generators as improved or temporary sources of electric power during prolonged power outages; Prepare the manuscript for a guidance and procedures manual for utilizing emergency power sources.

Pub. Sep. 71. 75p., NTIS No. AD-741 386. PC \$3.00 MF \$0.95

SUPPORTED BY U.S. Dept. of Defense - Army

16.0028, ASSESSMENT OF RESEARCH ON NATURAL HAZARDS

J.E. HAAS, Univ. of Colorado, School of Arts, Boulder, Colorado 80304

This supplements NSF award (GI-32942). The principal objectives of the basic award are to: 1) develop standard criteria for the production of social and economic cost data on major natural hazards and to determine the population at risk; 2) assess for the nation, its regions and states the present and prospective economic and social cost from major natural hazards and alternative feasible ways of reducing these; 3) to prepare a program statement of needed research and the expected payoffs, and 4) to involve academic and user communities throughout the research process.

All of the items in the supplemental budget are consistent with the above objectives. The supplemental budget will enable the project staff to develop much more adequate utilization plans through a more generous publication budget and the conduct of a major conference at Estes Park, October 15-19, 1973. The supplement also makes provisions for the continued use of its active and concerned Advisory Committee. The supplement requests funds for additional computer costs and a related subcontract to Travelers Insurance Company for additional labor on the simulation models which this project has been developing. The simulation model for floods, as noted by documents in the project file, has already been used by the U.S. Corps of Engineers. The Advisory Committee has continued to encourage the project's modeling efforts. At its last meeting the Committee again strongly endorsed this work and urged that additional funds be secured through a supplemental request. Mr. Robert Schnabel, Chief, Disaster Preparedness Division, FDAA, expressed the hope that his agency would soon be able to utilize the project's models. The initial award provided \$11,500 for computer services and this sum has been expended or encumbered. The supplement requests \$12,168 for additional computer work and \$4,616 for labor on a related subcontract with Travelers Insurance Company.

The expanded utilization effort which this supplement supports will aid the SSHR Division in its efforts to evaluate the products from the research which it supports.

SUPPORTED BY U.S. Natl. Science Foundation

Reduction in the time from the onset of initial response until the provision of definitive medical care of persons potential in saving lives and reducing disability. Although relatively little can be done to reduce travel time, communications techniques offer potential benefits by: improving citizen entry into the system, coordinating the dispatch of resources, and hospitals are alerted for arrival of patients, and professional medical advice and definitive intervention en route or at the scene of need.

Funds granted under this program will be utilized for and development costs of organizing a new emergency system. Examples of such costs are: training emergency dispatchers and ambulance attendants; communications hardware (such as mobile radio units and stations), and educating citizens in the use of the program is planned as a one-time national effort. Commitment provided for any financial support on a continuing basis, and is viewed as a needed major step to establish well-planned, compatible, regional emergency communications systems to coordinate emergency disaster medical services throughout geographic areas.

SUPPORTED BY R. W. Johnson Fund. - New Jersey

16.0030, NATURAL DISASTERS - SOME EMPIRICAL AND ECONOMIC CONSIDERATIONS

G.T. SAY, U.S. Dept. of Commerce, Natl. Bureau of Economic Research, Washington, District of Columbia 20234

This study examines the extent of some of the losses from natural disasters. An estimate of these losses is made in order to determine the potential benefits that could be realized from mitigating the negative economic impact of natural disasters. Absolute and relative losses from hurricanes, floods, earthquakes, and tornadoes are estimated. This data will help individuals, communities, and government make better decisions as to how and where protection against disasters should be provided. A comparison of benefit-cost analysis for choosing the optimal protection against disasters is also discussed. Recommendations are made for further research in determining the economic feasibility of various techniques for mitigating the losses from disasters.

Pub. Feb. 74: 63p., U.S. Govt. Print. Office, SD C 70-010 or NTIS.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.B.

16.0031, EVALUATION OF EMERGENCY COMMUNICATION SYSTEMS

R.H. EMERY, U.S. Dept. of Transportation, Federal Highway Administration, Washington, District of Columbia 20591 (2R53081610)

Existing emergency communication systems are evaluated on the basis of data accumulated on their operation to establish a relationship of significant system characteristics to service.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation

16.0032, NATIONAL SEARCH AND RESCUE COMMUNICATION SYSTEM PLAN (PINSARS)

C. MUNDO, U.S. Dept. of Transportation, Transportation Systems Center, Cambridge, Massachusetts (0388880)(TRAIS)

The objective of this effort is to develop a conceptual plan for integration of search and rescue SAR telecommunications alerting and locating devices currently in being or under development. This requires an understanding of existing electronic SAR devices presently being used in military and civil applications as well as devices under development by the military and civil agencies. SAR telecommunication requirements and responsibilities must be interfaced with technical potentialities and economic constraints. From this interface analysis an optimum system will be postulated. A time phased plan will be prepared projecting the development, testing, and implementation sequence.

Document provided to S.S.I.E. by the T.R.A.I.S.

SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

16.0033, COMMUNICATIONS IN NATURAL DISASTERS

R.A. STALLINGS, Ohio State University, Disaster Research Center, Columbus, Ohio 43210

Abstract: Field data collected on a sample of twenty-four natural disasters in the United States during the years 1963 through 1970 are analyzed in a summary of communication processes and problems. Communication is defined as a process in which messages are sent from one point to another, while communication structure denotes the patterned relationships among parts linked in this process. Three kinds of communication structures are examined. Internal communication refers to message transmission between points within single organizations; interorganizational communication involves messages passing between two or more separate organizations; and public-to-organization communication refers to messages received by groups from a number of individual members of the general public. In the discussions of each of these three types of communication relationships, typical problems encountered in disaster situations are mentioned, the more common ways in which communication capability is increased and demands reduced are outlined, and the most frequent changes in communication patterns initiated following involvement in an actual disaster are described.

Pub. Jan. 71: 58p., NTIS No. AD-723 993: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0034, DESIGN AND IMPLEMENT A TRANSIT SYSTEM FOLLOWING A NATURAL DISASTER

UNKNOWN, Luzerne Co. Transp. Authority, Wilkes Barre, Pennsylvania 18711 (2R84232619)

The purpose of this project is to design and implement a transit system for use following a natural disaster with maximum retention of emergency generated riders. Ways of reducing auto congestion in the central business district are to be devised.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - U.M.T.A.

The purpose of this study is to develop methods for evaluation of impacts of highways on natural factors and natural factors on highways, means of broadly mapping such relationships, and means of conveying useful information for system and corridor location and design study stages. Natural factors include tides, floods, snows, subsidence, wind, fog, frost, erosion and earth movements, and earth heat.

Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

16.0036, PLAN FOR AN IMPROVED COMMUNICATIONS SYSTEM SERVING THE EMERGENCY SERVICE DEPARTMENTS OF THE CITY OF LOS ANGELES (ABBREV)

UNKNOWN, Hughes Aircraft Company, Fullerton, California 92634

Abstract: Because increasing requests for emergency services threaten to completely outgrow present capabilities for handling them, the City of Los Angeles recognized the need to develop an improved Emergency Command Control Communications System for their emergency service departments - police, fire and ambulance. The study defines a conceptual design and a master plan for such an integrated system.

Pub. Jan. 71: 49p., NTIS No. PB-202 250: PC \$3.00 MF \$0.95.

SUPPORTED BY No Formal Support Reported

16.0037, OPTIMUM UTILIZATION OF GOVERNMENT AND NON-GOVERNMENT COMMUNICATIONS RESOURCES

A.H. WEGANT, Stanford Research Institute, Menlo Park, California 94025

Abstract: A number of communication resources exist that are applicable to and available for Civil Defense emergencies to augment and substitute for common carrier and other primary communication means. The study describes the resources and comments on their applicability and the constraints on their utilization. A useful technique for providing guidance to local communications directors to assist in optimum use of communications resources is described.

Pub. Oct. 71: 160p., NTIS No. AD-734 855: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0038, URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORD, State Div. of Mines & Geology, Sacramento, California 95814

Abstract: This report recommends loss-reduction measures for 10 geologic problems which collectively threaten an estimated \$55 billion loss in California's urban areas from 1970 to 2000. The problems are earthquake shaking, loss of mineral resources to urbanization, landsliding, flooding, erosion activity, expansive soils, fault displacement, volcanic hazards, tsunami hazards, and subsidence. The report describes the nature, distribution, and magnitude of each problem, as well as costs and effectiveness of possible loss-reduction measures, and agencies responsible for those measures.

Pub. Jun 73: 111p., NTIS No. PB-222 447/5: PC \$7.75 MF \$0.95.

R.L. LAMOUREUX, System Development Corporation, Santa Monica, California 90406

Abstract: The final report of the improved outdoor alerting and warning project describes the role of improved outdoor alerting and warning in the overall warning system as it is currently being developed. It also describes the conclusions and recommendations concerning the areas identified as requiring further research and development.

Pub. Oct. 68: 111p., NTIS No. AD-845 552; PC \$3.00 MF \$0.95.

SUPPORTED BY No Formal Support Reported

16.0040, REGULATION OF GREAT LAKES WATER LEVELS - A SUMMARY REPORT/1974

UNKNOWN, Internat. Joint Commission, Washington, District of Columbia 20440

The report contains analyses, findings and conclusions of a study of the various factors which affect the fluctuations of the water levels of the Great Lakes, and which determine actions that would be practicable and in the public interest from the points of view of both the United States and Canadian Governments, for the purposes of bringing about a more beneficial range of stage for, and improvement in: (a) domestic water supply and sanitation; (b) navigation; (c) water for power and industry; (d) flood control; (e) agriculture; (f) fish and wildlife; (g) recreation; and (h) other beneficial public purposes. The report also contains Great Lakes physical and hydrological data.

Pub. 1974: 37p., No copy info. available.

Abstract provided by FDAA.

SUPPORTED BY No Formal Support Reported

16.0041, REGULATION OF GREAT LAKES WATER LEVELS REPORT TO THE INTERNATIONAL JOINT COMMISSION BY THE INTERNATIONAL GREAT LAKES LEVELS BOARD

UNKNOWN, Internat. Joint Commission, Washington, District of Columbia 20440

The purpose of this study are: (1) to review the various factors affecting the fluctuations of the water levels of the Great Lakes; (2) to determine the feasibility of regulating further the water levels in the Great Lakes and connecting channels so as to bring about a more beneficial range of stage and other improvements for the purposes enumerated in the Reference; (3) to determine the changes in existing works or other measures within the basin needed to accomplish such regulation that would be practicable and in the public interest; (4) to provide an estimate of the costs of such measures; and (5) to indicate the probable effects, beneficial or adverse, in each country of any regulation plans or measures proposed. The study considers all major interests affected by the water levels of the Great Lakes.

Pub. Dec. 73: 294p., No copy info. Available.

Abstract provided by FDAA.

SUPPORTED BY No Formal Support Reported

16.0042, EMERGENCY EQUIPMENT STANDARDS

A.T. HORTON, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234

Expected results. Report on Emergency Vehicle Lights; State of the Art. Standard for Flashing Standard for Sirens, User Guidelines for Lights and Sirens.

SUPPORTED BY U.S. Dept. of Justice

16.0043, ESSA AND OPERATION FORESIGHT

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic Atmos. Admin., Washington, District of Columbia 20540

A report on ESSA's performance before and during floods in the Midwest, March-April 1969, based on a study of how ESSA's River and Flood Forecast and Warning Service performed during the disastrous flood situation occurring in the Midwest. This report is a review of the effectiveness of forecasts and warnings prior to and during the disaster.

Pub. May 69: 44p., ESSA/PI 690030, U.S. Dept. of Commerce - ESSA

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - ESSA

16.0044, MINIMIZING DAMAGE TO REFINERIES IN THE EVENT OF A NUCLEAR ATTACK, NATURAL AND OTHER DISASTERS

M.M. STEPHENS, U.S. Dept. of the Interior, Office of Geology, Washington, District of Columbia 20242

Abstract: The object of this publication is to provide information on refinery management and technical personnel to determine the nature of the possible damage to installations and equipment caused by hurricanes, tornadoes, fires, earthquakes, and the similarity of such forces to those created by nuclear weapons; (2) The probable magnitude of the destruction resulting from a blast of nuclear disaster; (3) The research done by government agencies and industry which point out ways to make a modern oil refinery to make it more damage resistant within the realm of economic judgment. Other problems to be expected in time of war.

Pub. Feb. 70: 256p., NTIS No. AD-773 048/4; PC \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0045, SUMMARY REPORT - WEATHER MODIFICATION - FISCAL YEARS 1969, 1970, 1971

R.C. KOCH, Geomet Incorporated, Rockville, Maryland

This report summarizes the important developments in attempts to modify the weather that have occurred in the United States and abroad during the Federal fiscal years 1969, 1970 and 1971. The activities covered include operational and experimental studies in the field and laboratory. The weather phenomena include rain, hail, hurricanes, tornadoes, hailstorms, and fog. The report also evaluates social, economic, legal, and ecological impacts considered in addition to the technical aspects.

Pub. May 73: 163p., Pub. USDC, NOAA, GPO: 0317-00101, PC \$1.25.

Abstract provided by FOAA.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

16.0046, FEDERAL PLAN FOR WEATHER RANGING

system needed to provide these vital services to the Nation. The Plan was prepared by the Interdepartmental Committee for Meteorological Services and the Interdepartmental Committee for Applied Meteorological Research. It replaces the Federal Plan for Weather Radars and Remote Displays issued in December 1969.

This Plan has been developed in response to guidelines provided by OMB Circular A-62 and specific findings and recommendations in the Report to the Congress on Disaster Preparedness by the Office of Emergency Preparedness, January 1972, The Agnes Floods by the National Advisory Committee on Oceans and Atmosphere, November 22, 1972, and other disaster survey reports. Concepts developed in earlier Plans have been updated to take advantage of modern technology. Federal agencies concerned with weather radar have participated in preparing this Plan; specifically, the Departments of Commerce, Defense, Interior, and Transportation, the National Aeronautics and Space Administration, and the National Science Foundation.

Pub. Nov. 1973; 58p., stock no. FCM 73-5. U.S. Dept. Comm., NOAA, Wash., D.C.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

16.0047, A DIGITAL SIMULATION OF MESSAGE TRAFFIC FOR NATURAL DISASTER WARNING COMMUNICATIONS SATELLITE

G.F. HEIN, U.S. Natl. Aero. & Space Adm., Lewis Research Center, Cleveland, Ohio

Abstract: Various types of weather communications are required to alert industries and the general public about the impending occurrence of tornados, hurricanes, snowstorms, floods, etc. A natural disaster warning satellite system has been proposed for meeting the communications requirements of the National Oceanic and Atmospheric Administration. Message traffic for a communications satellite was simulated with a digital computer in order to determine the number of communications channels to meet system requirements. Poisson inputs are used for arrivals and an exponential distribution is used for service.

Pub. 1972; 60p., NTIS Nn. N72-32182; PC \$5.00 MF \$0.95.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

16.0048, DISASTER WARNING SATELLITE STUDY

UNKNOWN, U.S. Natl. Aero. & Space Adm., Lewis Research Center, Cleveland, Ohio

Abstract: The Disaster Warning Satellite System is described. It will provide NOAA with an independent, mass communication system for the purpose of warning the public of impending disaster and issuing bulletins for corrective action to protect lives and property. The system consists of three major segments. The first segment is the network of state or regional offices that communicate with the central ground station; the second segment is the satellite that relays information from ground stations to home receivers; the third segment is composed of the home receivers that receive information from the satellite and provide an audio output to the public. The ground stations required in this system are linked together by two, separate, voice bandwidth communication channels on the Disaster Warning Satellites so that a communications link would be available in the event of disruption of

16.0049, INITIAL OBSERVATIONS ON PROBLEMS AND DIFFICULTIES IN THE USE OF LOCAL EOC'S IN NATURAL DISASTERS

E.L. QUARANTELLI, Ohio State University, Disaster Research Center, Columbus, Ohio 43210

Abstract: An initial examination was made of the use of emergency operations centers (EOCs) in natural disasters in American society in the last eight years. Problem areas were noted in participation in EOCs, tasks carried out at EOCs, the location of EOCs, and the time of activation of EOCs. However, EOCs were found to be of value and important in a response to community emergencies.

Pub. May 72; 7p., NTIS No. AD-745 407; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

HAZARD REDUCTION

16.0050, PUBLIC SAFETY SUBSYSTEM - VOLUME 1 - ANALYSIS OVERVIEW

UNKNOWN, Unknown Inst. or Indiv. Grant, California

Abstract: The report is from a USAC series produced by the City of Long Beach, California, covering activities from systems analysis through implementation and evaluation of urban information systems. It is an overview of the systems analysis of the public safety function. Public safety in the City of Long Beach is performed by the police, fire and emergency preparedness departments. In addition, licensing and code enforcement as it relates to public safety is included. The summary report depicts current operations of the various public safety components and their relation to other municipal, state, and federal agencies. The activities and findings related to the systems analysis, which are requisite to implementing a prototype information system, are documented.

Pub. Nov. 70; 41p., NTIS No. PB-208 488-01; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0051, PUBLIC SAFETY SUBSYSTEM - CONCEPTUALIZATION TASK COMPLETION REPORT

UNKNOWN, Unknown Inst. or Indiv. Grant, California

Abstract: The report is from a USAC series produced by the City of Long Beach, California, covering activities from systems analysis through implementation and evaluation of urban information systems. It documents findings related to the development of system concepts at the component level. Components are conceptualized for the police, fire, and emergency preparedness functions. The concepts are derived from findings obtained in the systems analysis task and from the functional requirements which were so identified. Task objectives are delineated, and task methodology is given. Regional and state interfaces are also identified.

Pub. Feb. 71; 294p., NTIS No. PB-208 489; PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0052, THE DEVELOPMENT OF A MEANS FOR ASSESSING EMERGENCY MEDICAL RESOURCES

extent of its medical resources. As a contribution of the five-city study, the resources in San Jose, California are assessed, and then subjected to a hypothetical nuclear detonation. Models are developed which evaluate the weapon effects on the resources and the demand for them that is generated by the injuries caused by the detonation. Measures of effectiveness for any post-attack medical treatment system are also discussed.

Pub. Aug. 69: 126p., NTIS No. AD-866 717 PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0053, NATURAL DISASTER OPERATIONS PLANNING

C.T. RAINEY, Stanford Research Institute, Menlo Park, California 94025

Abstract: This research was concerned with development of a general concept of emergency operations for natural disaster situations and a prototype natural disaster operations plan (NADOP). The concept is based on classifying the several types of disaster agents according to whether they have a destructive impact or a paralyzing effect on an operating zone. Contingencies provided for in the concept include alert, distant from impact, close to impact, damaged, but renewable, untenable, moderate hazards, and extreme hazards. Countermeasure actions are identified for each contingency. Nine basic operating situations (BOS) are defined according to the severity (negligible, moderate, extreme) of the threats posed by each class of disaster agent, either singly or in combination.

Pub. Mar. 72: 63p., NTIS No. AD-740 187: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0054, ENVIRONMENTAL PLANNING AND GEOLOGY - PROCEEDINGS OF THE SYMPOSIUM ON ENGINEERING GEOLOGY IN THE URBAN ENVIRONMENT

D.R. NICHOLS, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The quality of the environment and the application of earth science data to planning for urban areas are of concern to both the Department of Housing and Urban Development and the Department of the Interior. These agencies are jointly sponsoring an environmental planning research and demonstration study in the San Francisco Bay region which will guide similar planning efforts throughout the Nation. This study is designed to develop and interpret earth science data so that we may improve comprehensive planning on regional, county, and local scales and establish a sound basis for environmental decision-making when urban expansion occurs.

Pub. 1971: 204p., stock No. 2300-1195, U.S. Govt. Printing office, Wash., D.C., PC \$2.75.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

16.0055, GEOLOGIC ENVIRONMENTAL MAPS FOR LAND-USE PLANNING, CALIFORNIA

E.H. PAMPEYAN, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

States to which project pertains: California.

Small-scale (1:250,000) maps of coastal California are being

large landslides, ground subsidence, and engineering properties of rock and sediment units.

Graphic and conceptual techniques depicting in map form what is known about recency of fault displacement have been devised. Using these techniques, a pilot geologic environmental map of the greater Los Angeles area has been compiled and published, together with explanatory text and table of engineering properties. A map showing recency of faulting in coastal southern California has been prepared and will be released in 1974.

The coastal strip from Point Arguello to Monterey Bay will be completed during 1974. The Monterey Bay to Point Arena strip will be compiled in 1974-75 largely from data gathered during the USGS-HUD San Francisco Bay Region study. The segment between Point Arena and Oregon, which will require more extensive field investigations because of limited existing sources of geologic data, will be compiled later.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

16.0056, SOIL ENGINEERING RESEARCH - CALIFORNIA

T.L. YOUNG, U.S. Dept. of the Interior, Geological Survey, Menlo Park, California 94025

The Soil Engineering Research Project: (1) Contributes to interdisciplinary topical investigations of engineering geologic problems and hazards with original research concerning, and applications of, soil engineering principles and methods. Current emphasis is on the potential hazards associated with the San Francisco Bay sediments; specifically, seismic ground amplification, liquefaction susceptibility of granular deposits, static and seismic stability of slopes and dikes, total and differential settlement from overburdened fills, and subsidence from groundwater extraction. (2) Supports regional engineering geologic and environmental geologic studies with (a) determinations of the engineering classification and in situ state properties of unconsolidated earth deposits, (b) correlations of these properties with geologic variables, and (c) interpretations of their significance for land-use planning and engineering purposes. Current emphasis is on the unconsolidated deposits and residual soils in the San Francisco Bay region.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

16.0057, ON ESTIMATION OF MAXIMUM WIND SPEEDS IN TORNADOES AND HURRICANES

P. DERGABEDIAN, T R W Incorporated, Redondo Beach, California 90278

Abstract: Two methods are proposed for estimating maximum azimuthal velocity component for fully-developed meteorological vortices from data usually available. One method, principally for tornadoes, uses photographic evidence of the cloud-deck height, the core radius, and the funnel shape. The other, applicable to both tornadoes and hurricanes, uses the tephigram for air at the outer edge of the storm. Calculated cases confirm that the lower maximum wind speeds suggested by recent workers (crudely one-quarter of sonic speed for sea-level air) are more plausible for tornadoes than the sonic speeds sometimes cited a decade ago. Furthermore, winds of hurricane magnitude and more are shown to be consistent with a model in which heat and mass transfer between ocean and the very low atmosphere is taken as negligible in a fully developed typhoon. The suggestion is made that while heat and mass transfer from the ocean or lower atmosphere may be important in the transient

16.0058, THE SEISMIC SAFETY STUDY FOR THE GENERAL PLAN

D. ARMSTRONG, Tri Cities Seismic Safe. Study, *Richmond, California* 94806

The Seismic Safety Study for the General Plan is one of three reports issued by the Tri-Cities Study. Pursuant to State Law enacted in 1972, all California cities must include a Seismic Safety Element in their General Plan. This Study is the first major Seismic Safety Study for the General Plan produced in the State and will be distributed as a model to all California cities by the California Council on Intergovernmental Relations. The essential parts of the Seismic Study are: 1) Detailed Findings of the earthquake situation in the Tri-Cities Areas, including geologic and structural factors, present uses and disaster implications, 2) Policies to guide future development and regulate existing development, and 3) Specific recommendations for action by the cities.

Pub. Sept. 73: 199p., Calif. Council on Intergovernmental Relations, Sacramento, Calif. 95816, and NTIS.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0059, EMERGENCY OPERATIONS CONTINGENCY PLANNING - NEW ORLEANS, LOUISIANA

A.I. ABERSMAN, System Development Corporation, *Santa Monica, California* 90406

Abstract: The document describes the results of a study for the development of prototype emergency operations contingency plans based upon the operational environment found in New Orleans, Louisiana. The report describes the study method used; the concept of operation under which the plans would be developed; it critiques and evaluates the planning methods; and provides recommendations for planning. Appendices contain examples, for developmental use only, of prototype plans which were developed from this study for operating zones.

Pub. Mar. 69: 199p., NTIS No. AD-849 888: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0060, DEVELOPMENT OF IMPROVED EMERGENCY OPERATIONS SIMULATION TRAINING (EOST) TRAINING PROCEDURES

R.C. HARKER, System Development Corporation, *Santa Monica, California* 90406

Abstract: The report presents procedures for the development of improved DCPA (Defense Civil Preparedness Agency) Emergency Operations Simulation Training (EOST) exercises conducted for local jurisdictions. The Research Directorate of DCPA is developing a set of Emergency Operating Planning Master Checklist documents relating to nuclear (NEOP) and natural (NADOP) disasters and covering zonal and areawide government operations. These documents are admirably suited to provide bases for local planning as they include recognition of damage from current estimates of nuclear attack capabilities and from natural disasters. Data are being developed for countermeasure actions relating to crisis buildup and warning periods as well as to post-attack recovery and remedial movement. The revised procedures for the improved EOST exercise program specifically include the use of the Master Checklist documents as the bases for the

16.0061, A COMPARATIVE ANALYSIS OF PUBLIC SUPPORT OF AND RESISTANCE TO WEATHER MODIFICATION PROJECTS

J.E. HAAS, Univ. of Colorado, Graduate School, *Boulder, Colorado* 80302

This grant is a continuation of research conducted under GA-28364, and examines the conditions and agency actions which encourage public and interested group support rather than resistance to planned weather modification projects. Since planned weather modification efforts are moving increasingly from experimental to operational projects, the attitude of the public toward such operations is rapidly becoming a crucial factor in determining whether such programs will continue to be supported. It is evident that the way in which weather modification scientists and administrators approach the economic and social conditions in and near the target area may be the deciding factor as to whether conflict or acceptance will result. Existing or planned projects will be examined whether funded by Federal or State sources as well as those funded by local citizens and carried out by commercial operators. It is expected that this study will result in a set of policy guidelines for site selection and for working with interested persons and groups during the course of weather modification projects, to insure that the public will be adequately informed and that maximum benefits may be derived from the economic and social standpoint.

SUPPORTED BY U.S. Natl. Science Foundation

16.0062, UNIVERSITY-INDUSTRY WORKSHOP ON HAZARDS AND DAMAGE RELATED TO EXPANSIVE EARTH MATERIALS

D. RICHARD, Univ. of Denver, Graduate School, *Denver, Colorado* 80210

This workshop will attempt to summarize the state-of-the-art and critical areas needing research in the area of the behavior of expansive earth materials. Damage resulting from the action of expansive or shrinking earth materials was estimated at 2 billion dollars per year in a recent ASCE-Civil Engineering Magazine article.

The workshop will consist of general discussions and five specific areas of interest as follows: 1. Pavements - highways, roads, streets, airports and parking facilities. 2. Light Buildings - residential buildings, schools, light commercial buildings, etc. 3. Heavy Buildings - single and multistory industrial and commercial buildings, power and pumping plants, etc. 4. Other Facilities Problems - buried utilities, canals, large pipelines, dams, landslides, etc. 5. Organization, planning and financing for accomplishing general objectives, as related to Workshop findings. Coordination, liaison and technical input to assigned groups.

SUPPORTED BY U.S. Natl. Science Foundation

16.0063, WEATHER AND CLIMATE MODIFICATION - PROBLEMS AND PROGRESS

UNKNOWN, Natl. Acad. of Sciences, *Washington, District of Columbia* 20037

Abstract: The report not only emphasizes outstanding problems but also reviews recent work on the artificial modification of precipitation, the dissipation of fogs, and the modification of hailstorms, hurricanes, and other weather hazards. It also considers the important role of statistics in meeting requirements for better experimental designs and more relevant techniques for data analysis. In discussing national goals for

tion of local weather and global climate as a result of human activities.

Pub. Jun. 73: 275p., NTIS No. PB-224 193/3: MF \$1.45.

SUPPORTED BY Natl. Academy of Sciences - Washington

16.0064, FIELD STUDIES OF DISASTER BEHAVIOR - AN INVENTORY

UNKNOWN, Natl. Acad. of Sciences, Washington, District of Columbia 20037

Abstract: The document provides a relatively complete list of the field studies on human behavior in disasters that have been conducted by behavioral scientists. It is intended to assist research personnel, administrators, and others interested in disaster research findings in the identification and location of pertinent reports and other research products. Emphasis in the inventory is primarily on studies of peacetime disasters affecting civilian groups and populations. It catalogs 114 field studies of human behavior in 103 different disaster situations. It provides a brief description of each event; the date, location, and damage produced; the number of interviews obtained in the study; the agency and personnel responsible for the research; and a list of the pertinent published and unpublished reports.

Pub. 1961: 89p., NTIS No. AD-267 652/6: PC \$6.50 MF \$1.45.

SUPPORTED BY Natl. Academy of Sciences - Washington

16.0065, TOWARD REDUCTION OF LOSSES FROM EARTHQUAKES

UNKNOWN, Natl. Acad. of Sciences, Washington, District of Columbia 20037

This condensed summary of conclusions reached by the Committee on the Alaska Earthquake suggests measures that can be taken to minimize loss of life and property in future earthquakes. It is based on a careful review of events during and following the disaster that befell south central Alaska in March 1964. Emphasis is on lessons to be learned from the Alaskan experience that can be applied to any region where strong earthquakes may be expected.

The Committee's recommendations are given in the first chapter. The second chapter presents the more detailed conclusions reached by the seven specialized panels among which the Committee's work was divided. The final chapter is a brief recounting of the major events of the Alaska earthquake and its aftermath, to call to mind the experience on which the recommendations are based.

Pub. 1969: 35p., Printing and Publishing Office, Natl. Academy of Sciences, Wash., D.C.

Abstract provided by FDAA.

SUPPORTED BY Natl. Academy of Sciences - Washington

16.0066, WEATHER & CLIMATE MODIFICATION PROBLEMS AND PROGRESS

UNKNOWN, Natl. Acad. of Sciences, Washington, District of Columbia 20037

An evaluation in depth of technical programs covering the whole spectrum of weather modification activities, including inadvertent changes, and recommendations for continuing carefully devised experiments to define the limitations as well as the capabilities of such activities.

Pub. 1973: 258p., Print. & Pub. Off., NAS.

Abstract provided by FDAA.

R.I. PYLE, U.S. Dept. of Commerce, Natl. En-
Serv., Washington, District of Columbia 20230

Abstract: The paper presents a summary of present satellite capabilities and indicates that its full potential only begin to be realized. Weather satellites provide a wide variety of direct, continuing benefits to observation and prediction programs in the United States and overseas. Major applications have been in weather and forecasting services but satellite data are increasing extent in other environmental service activities, hydrology, space disturbance monitoring, and others. Examples are given to show how satellite data are contributing to better weather forecasts, more accurate bulletins, and more reliable warnings of natural hazards.

Pub. 1972: 12p., NTIS No. COM-73-10327: Rep.
SUPPORTED BY U.S. Dept. of Commerce - N

16.0068, FEDERAL PLAN FOR WEATHER RADAR RESOURCES

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20037

Abstract: The plan for weather radars describes the current and potential weather radar resources in providing forecasts of severe weather for all walks of life. U.S. Information is given on disaster warning, weather forecasting, special Department of Defense operations, and operational concepts. An integrated weather radar network has been constituted to provide services to the Nation. This operational system consists of 57 radars operated by NOAA and 11 AN/CPS-9, and AN/FPS-41 weather radars of the Dept. of Defense on an interim basis. Also planned for the network are 23 AN/FPS-77 and AN/CPS-9 facilities of the Dept. of Defense acting as alternate sites.

Pub. Nov. 73: GSP., NTIS No. COM-74-10201/3: MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - N

16.0069, FEDERAL PLAN FOR METEOROLOGICAL SERVICES & SUPPORTING RESEARCH - FY 1973

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20037

Abstract: Provided is a description of the Basic and Advanced Meteorological Services and of the various agencies improving these services. Additionally, a special section is provided in the area of weather disaster warning covers the programs of all agencies for FY 1973. Much of the FY 1973 activity is aimed at improving the basic meteorological system through activities, utilizing larger capacity computers, improved forecasting models, and improving the preparation of the public to respond to warnings.

Pub. Jan. 72: 77p., NTIS No. COM-72-50391: MF \$0.95

SUPPORTED BY U.S. Dept. of Commerce - N

16.0070, FEDERAL PLAN FOR METEOROLOGICAL SERVICES & SUPPORTING RESEARCH - FY 1975

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20037

programs designed to reduce the economic and social impact of natural disasters, promote the Nation's welfare and economy, preserve and enhance the environment and strengthen the national security.

The introductory section to this Plan highlights many aspects of interagency cooperation that is so essential to meet the needs for meteorological services now and for the challenges of the future. This section is followed by a brief fiscal summary of the overall Plan.

Basic and Specialized Meteorological Services and Supporting Research are described in the next section along with the operational and research programs for fiscal year 1975. The fourth major section of this Plan treats meteorological services from the functional viewpoint. Observations, analyses and forecasts, communications, dissemination, and general agency support are covered.

The final section describes the meteorological satellite program as a separate discussion. The last page of this Plan lists the publications prepared, or in the process of preparation, by the Federal Coordinator for Meteorological Services and Supporting Research.

The coordination of weather activities and the preparation of the Federal Plan is performed by the interagency committees shown on the inside front cover. These committees and their subcommittees conduct systematic, continuous reviews of basic and specialized meteorological requirements, services, and supporting research.

Pub. June 74; 60p., U.S. Dept. Comm. NOAA, Wash., D.C.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

16.0071, A FEDERAL PLAN FOR NATURAL DISASTER WARNING AND PREPAREDNESS

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., Washington, District of Columbia 20235

The 'Report to the Congress on Disaster Preparedness' by the Office of Emergency Preparedness, January 1972, and the report, 'The Agnes Floods' by the National Advisory Committee on Oceans and Atmosphere, November 22, 1972, together with other disaster surveys, have identified many unmet needs in the existing natural disaster warning system and community preparedness. This Plan addresses those unmet needs within the concept of a balanced program which recognizes the close interaction between the warning system and community preparedness. The unmet needs are many, however, and together with the very nature and complexity of the phenomena with which we are dealing lead to program planning that extends over several years in order to achieve improvements necessary to meet these needs. Assuming a continuation of current priorities and present rate of funding, this Plan describes the long-range efforts of all Federal agencies with responsibilities to warn about, prepare for, and mitigate the impact of potential geophysical natural disasters, including those caused by hurricanes, tornadoes, floods and earthquakes. In this Executive Summary of the Plan, features of the warning system and community preparedness that are common to several of these phenomena are discussed first, followed by sections dealing with the specific phenomena.

Pub. June 73; 123p., U.S. Govt Printing Office, Wash. D.C., PC \$2.10.

UNKNOWN, U.S. Dept. of Commerce, Off. of Plans & Programs, Washington, District of Columbia 20234

This National Oceanic and Atmospheric Administration Plan to Improve Local Weather Forecasts places particular emphasis on the 0-to 6-hour time period of the weather service to the general public and special user groups. As a result of the varied needs of these services, the meteorological problems within the present range of interest are many and diverse. Also involved are internal operating procedures and methods of working with the public.

The program identifies fundamental problems that must be solved if we are to improve the timeliness and accuracy of forecasts and warnings. The achievement of this objective is dependent on an experimental facility to be utilized for 1) development of equipment and technology, 2) translation of new knowledge and theory into operational forecast procedure, and 3) support to specialized data gathering projects.

The plan includes cost estimates of the many interrelated actions to be accomplished in five phases. These estimates may require adjustment as the results of R&D efforts are applied and the need for new equipment, procedures, and research become apparent.

Pub. Mar. 71; 43p., U.S. Dept. Comm. NOAA, Wash., D.C.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

16.0073, BUILDING PRACTICES FOR DISASTER MITIGATION

R.N. WRIGHT, U.S. Dept. of Commerce, Natl. Bureau of Standards, Washington, District of Columbia 20234

Abstract: The National Workshop on Building Practices for Disaster Mitigation was concerned with earthquakes, extreme winds, and similar dynamic hazards. These proceedings present recommendations derived at the workshop and addressed to policy makers in government and industry, as well as practitioners in engineering, architecture, land use planning, and the earth and meteorological sciences. The recommendations evaluate current building practices, define opportunities for improving current practice from documented research findings, and recommend research to fill gaps in knowledge. The objectives include avoidance of human suffering, reduction of property loss, and maintenance of vital function in buildings under conditions threatening disaster. Fifteen review articles were prepared by experts in the professions and research disciplines to define the state of the art in disaster mitigation and to guide discussions at the workshop; the articles are included in the proceedings.

Pub. Feb. 73; 482p., NTIS No. COM-73-50188; PC-GPO MF \$0.95.

SUPPORTED BY U.S. Dept. of Commerce - N.B.S.

16.0074, SEISMIC HAZARDS AND LAND-USE PLANNING

D.R. NICHOLS, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Basic earth-science data are necessary for a realistic assessment of seismic hazards and as a basis for limiting corrective land-use controls only to those areas of greatest hazard. For example, the location, character, and amount of likely displacement and activity of surface faulting can be predicted if detailed geologic maps and seismic data are available and are

Two methods of predicting ground shaking effects have applications to land-use decisions: (1) Relative earthquake effects can be related to firmness of the ground and can be used in a gross way to allocate population density in the absence of more sophisticated analyses; and (2) intensity maps, based on (a) damage from former earthquakes, or (b) a qualitative analyses of geologic units added to a design earthquake, can be helpful both for general and specific plans. Theoretical models are used with caution to predict ground motion for critical structures to be located at specific sites with unique foundation conditions. Fully adequate methods of assessing possible shaking remain to be developed. Where land-use decisions do not reflect likely ground shaking effects, stringent building codes are needed, particularly for important structures.

Ground failure (landsliding, ground cracking and lurching, differential settlement, sand boils, and subsidence) commonly results from liquefaction, loss of soil strength, or compaction. Areas suspected of being most likely to fail should not be developed unless detailed site studies can demonstrate the hazard does not exist or can be overcome. Various methods can be used to reduce the high, long-term public costs that follow development of unstable ground. However, areas subject to tectonic deformation generally cannot be predicted nor can effects of such deformation be minimized.

Large water waves, such as produced by tsunamis, seiches, and dam failure or overtopping, can be anticipated in many places. (Text Abridged)

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

16.0075, PROGRAM DESIGN-1971 - SAN FRANCISCO BAY REGION ENVIRONMENT AND RESOURCES PLANNING STUDY

UNKNOWN, U.S. Dept. of the Interior, Geological Survey, Washington, District of Columbia 20242

Abstract: A comprehensive guide to a study of the 9-county San Francisco Bay Region describes a 4 year research-demonstration study conducted jointly by the Geological Survey and the Department of Housing and Urban Development, designed to improve urban development decisions and land-use planning through application of innovative earth science concepts. Urban-related environmental studies include: active faults and earthquake hazards, landslides and slope instability, physical and chemical properties of San Francisco Bay and its circulation patterns, water-quality and pollution, areas subject to flooding, water supply and waste-disposal systems, and available mineral and water resources. Planning program elements described include state-of-the-art review and analysis, a feasibility study of incorporating earth-science data into urban planning information systems, and application and demonstration studies.

Pub. Oct. 71: 121p., NTIS No. PB-206 826. PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

16.0076, NATIONAL ATMOSPHERIC SCIENCES PROGRAM - FISCAL YEAR 1974

UNKNOWN, U.S. Exec. Office of the Pres., Off. of Science & Technology, Washington, District of Columbia 20006

This National Atmospheric Sciences Program Report, prepared annually in the Spring, serves a number of essential and useful purposes. Primarily, it is intended to inform the Executive

There are two other principal documents related to the ICAS Annual Report. They are published as the Federal Coordinator for Meteorological Services Reporting Research (FCMS&SR). The first of these is the Federal Plan for Meteorological Services and Research, which is submitted to the Congress as part of the Management and Budget in accordance with 87-843. The second is the World Weather Program, which is transmitted annually to the Congress. The latter plan describes the U.S. participation in the World Weather Watch and the Atmospheric Research Program.

The ICAS Annual Report which follows begins with a table which sets forth the fiscal funding for the atmospheric sciences programs. The principal report follows the fiscal data and contains descriptions of the member agency programs. The third part of the report contains a more detailed discussion of weather modification programs. The Research Classification System upon which the categories used in the report are based, and the mentioned subcommittee descriptions.

Pub. May 73: ICAS 17-FY 74.

Abstract provided by FDAA.

SUPPORTED BY No Formal Support Reported

16.0077, REPORT TO THE CONGRESS ON DISASTER PREPAREDNESS

UNKNOWN, U.S. Exec. Office of the Pres., Off. of Management, Washington, District of Columbia 20006

The report reflects a comprehensive study of the natural disasters experienced in the United States and the findings and potential solutions to prevent or reduce loss of life and damage to property. Careful attention was given to the views of Federal agencies, State and local governments, professional and trade associations, and academic institutions, private volunteer organizations, and individual experts. The final analysis and recommendations, however, were developed independently by an Office of Management Preparedness Disaster Study Group. The report points to the need for improved disaster preparedness at all levels. The findings contain recommendations for moving further toward an improved national disaster preparedness program.

Pub. Jan. 72: 195p., U.S. Govt. Print. Office, Stock Number 0006, PC \$2.75.

Abstract provided by FDAA.

SUPPORTED BY U.S. Executive Office - O.E.O.

16.0078, LABORATORY STUDIES OF THE PHYSICAL HAZARD ON SHELTER MANAGER BEHAVIOR - PHASE I - STUDY PLAN

T.R. ARMSTRONG, Amer. Inst. for Res., Miami, Florida 33136

Abstract: The goal of the project was to develop a mental design and supporting materials and procedures for a research project intended to identify and validate effective management behavior under threat. The product of the project is a Study Plan intended to be used as a laboratory study of the effects of human leadership/management behavior, relative to the situation of a shelter manager in an actual disaster.

Pub. Dec. 72: 66p., NTIS No. AD-759 843: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0079, THE INVESTIGATION OF SHELTER MANAGEMENT AND CONTROL IN NATURAL DISASTER

R.A. COLLINS, Amer. Inst. for Res., Miami, Florida

Abstract: The study was performed to determine: (1) what management problems existed in natural disaster shelters and (2) the excellence of the natural disaster shelter situation as a source of information relevant to fallout shelter management. Contracts were made through the American Red Cross with individuals who had been sheltered as a result of some natural disaster and who had taken on management as well as non-management roles. Most of these individuals were found in the Harrisburg, Pennsylvania, area and had experienced sheltering as a result of the flooding of that area following Hurricane Agnes. Results of the interview of these individuals indicated that although many of the functions of a fallout shelter were performed in a natural disaster shelter, some critical ones were not. Furthermore, the environment in which these functions were performed was in no way similar to what would be expected of a fallout shelter situation in terms of availability of outside assistance, need for confinement, supply shortages, density of living, etc. Some management problems were abstracted from the natural disaster shelter setting, including management fatigue, information conflict and identification and control of volunteers.

Pub. Dec. 72: 55p., NTIS No. AD-759 842: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0080, SARASOTA - ZONING AND SUBDIVISION CONTROLS - REVIEW, ANALYSIS, AND RECOMMENDATIONS CONCERNING CURRENT REGULATIONS

E.R. BARTLEY, Tampa Bay Regional Plan. Coun., St. Petersburg, Florida

Abstract: Contents: Sarasota's authority to zone; The existing Sarasota zoning code (The legislative context, the judicial context, the executive); District regulations; Special problems-treatment of non-conformities; The current Sarasota zoning code; The current Sarasota subdivision regulations.

Pub. Jan. 70: 185p., NTIS No. PB-195 647: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0081, A COMPREHENSIVE PLAN FOR STEPHENSON COUNTY, ILLINOIS

UNKNOWN, Stephenson Co. Planning Comm., Freeport, Illinois 61032

Abstract: The Stephenson County Comprehensive Plan is an integration of the plans of the local communities based upon the broad framework of a plan for the entire county including environmental factors, land utilization, highways, drainage, community facilities, recreation, and housing. Based upon an analysis of the data, the comprehensive plan includes recommendations for land use, thoroughfares, community facilities, public buildings and public utilities. The

Lake Lu-Aqua-Na State Park; development and re U.S. Route 20; development of a major park or Run Creek; and development of vacation housing.

Pub. Jul. 70: 341p., NTIS No. PB-193 922: HC \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban ment

16.0082, CLIMATOLOGICAL ASSESSMENT OF EFFECTS ON PRECIPITATION - PART I

F.A. HUFF, State Water Survey, Urbana, Illinois 618

Abstract: This is a two-year project involving ext matological analyses of urban effects on precipit around eight major cities in central and easter States. Analyses were made initially of monthly ar precipitation within a radius of 50 to 75 miles of Diurnal rainfall distributions are discussed for Chicago, Cleveland, and Washington. Evidence w non-existent at Indianapolis, Tulsa, and New Orle effects at Houston could be identified only in May rainfall of air mass origin. The urban effect app more pronounced in summer than in winter and us imized 10-35 miles downwind of the central city had thunder increases ranging from 13 to 47 per the climatic background, and the maximum area c creases in hail ranged from 90 to 350 percent.

Pub. May 72: 39p., NTIS No. PB-228 757/1: PC \$1.45.

SUPPORTED BY U.S. Natl. Science Foundation

16.0083, ZONING ORDINANCE - KNOX COUNTY ANA

UNKNOWN, Clyde E. Williams & Assoc. Inc, Indiana diana

Abstract: Standards and maps are presented for unincorporated area of Knox County, Indiana.

Pub. Dec. 71: 150p., NTIS No. PB-206 088: PC \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban ment

16.0084, ECONOMIC FACTORS AFFECTING CI THE INTENSITY OF FLOOD PLAIN USE

J.R. BARNARD, Iowa State University, Water Research Inst., Ames, Iowa 50010

Abstract: The extent of agricultural land use char floodplain of the Iowa River as a result of the buil Coralville Dam is examined. The dollar values from land use change are estimated and compa original project study estimates prepared by the C engineers. The study also analyzes the factors affecti change.

Pub. Dec. 71: 13p., NTIS No. PB-208 610: PC \$0.95.

SUPPORTED BY U.S. Dept. of Interior - O.W.R.T

16.0085, AN ANALYSIS OF OPERATING SYSTE TIVENESS - FOCUS ON THE BEHAVIOR O COORDINATORS

C.T. GRIFFIN, Iowa State University, School of Scie Iowa 50010

Abstract: The study introduces and develops a theoretical and conceptual model of local coordinator response to disaster. Prediction and explanation of role performance following disaster was achieved by developing a causal model of disaster or operating system role performance. Path analysis techniques were applied to data from local coordinators in Minnesota, Iowa, Illinois and South Dakota who had experienced and responded to disasters. Considerable empirical support was obtained for hypotheses (model) stated in the form of generalizations. Relevant concepts included disaster, building and operating system role performance, organizational autonomy, uncertainty, role conflict, stress, prestige, communication, warning and need for information. Implications of the research for the training of coordinators and for future research are discussed.

Pub. Sep. 72: 47p., NTIS No. AD-748 839: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0086, ROLE PERFORMANCE IN THE OPERATING SYSTEM - CIVIL DEFENSE OPERATIONS IN DISASTER

C.L. MULFORD, Iowa State University, School of Science, Ames, Iowa 50010

Abstract: The study introduces a conceptual model of coordinator response to disaster and investigates the response of local coordinators in Minnesota, Iowa, Illinois and South Dakota to disasters. A total 123 phone screening interviews and 59 personal interviews were completed during the study. Comparison of operational and non-operational disaster coordinators were made on a number of activities that might occur before as well as following a disaster. Responses of operational coordinators to personal interview items were presented in terms of concepts such as disaster, building and operating system role performance, organizational autonomy, uncertainty, role conflict, stress, prestige, communication, warning and need for information. Implications of the research for disaster operations, overall civil defense program, the training of coordinators and for future research were presented.

Pub. Mar. 72: 88p., NTIS No. AD-743 953: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0087, SECURING COMMUNITY RESOURCES FOR SOCIAL ACTION

C.L. MULFORD, Iowa State University, School of Science, Ames, Iowa 50010

Abstract: This report analyzes local civil preparedness organizational effectiveness. The report focuses on the nature of organizations as 'open system,' the characteristics of organizations as systems, the organization's external environment, and external 'resource-acquisition' strategies, both primary and auxiliary. The analysis examines the overall use of these strategies and their relationship to four groups of selected variables (organizational resources, characteristics of coordinators, characteristics of jurisdictions, and the environmental status of the organization).

general welfare by providing for a reasonable, desirable comprehensive system or pattern of land use in the unincorporated area of the county, by preventing incompatible land uses, by lessening street congestion, avoiding undue concentration of population, by preventing erosion of land, by securing safety from fires and other dangers, by providing adequate light and ventilation, facilitating the provision of public and private services where applicable, by implementing the Land Use and other elements of the county's Comprehensive Land Use Plan.

Pub. Dec. 69: 93p., NTIS No. PB-192 700: H 1.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0089, ZONING ORDINANCE - PAINTSVILLE, OHIO

UNKNOWN, State Program Dev. Office, Franklin, Ohio 43061

Abstract: The revision of the ordinance contains regulations for the control of mobile homes, flood plain areas, and townhouses. These regulations were extracted from the ordinance obtained from the Department of Health, Planning and Welfare.

Pub. Jan. 71: 60p., NTIS No. PB-201 544: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0090, WEATHER MODIFICATION - HISTORICAL RECORD, 1969, 1970, 1971

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmospheric Admin., Rockville, Maryland 20852

Abstract: The report summarizes the important results of man's attempts to modify the weather that have taken place in the United States and abroad during the years of 1969, 1970, and 1971. The activities include observational and experimental studies in the laboratory. The weather phenomena included snowfall, hurricanes, tornadoes, hailstorms, and fog. In evaluating social, economic, legal, and ecological aspects, is considered in addition to the technical aspects.

Pub. May 73: 172p., NTIS No. COM-73-50671/9: H 1.00 MF \$1.45.

SUPPORTED BY U.S. Dept. of Commerce - NOAA

16.0091, CLIMATES OF THE STATES - CLIMATE DATA - NEW YORK

A.B. PACK, U.S. Dept. of Commerce, Natl. Oceanic & Atmospheric Admin., Silver Spring, Maryland 20910

Abstract: The data summary on the climate of New York presents a brief physical description of the state, descriptions of its general climatic features, its precipitation, snowfall, floods, winds and storms.

The meteorological, hydrological, and oceanographic operations of the National Weather Service are unique in nature and scope. The great variety of activities and their geographical dispersion creates a complex operating system. The purpose of this report is to summarize this system and place it in perspective.

The National Weather Service (NWS), under the National Oceanic and Atmospheric Administration, has a vast operating program. Its personnel are found at approximately 400 facilities within the 50 states and at 30 elsewhere. Altogether NWS has about 5,200 full-time employees working in meteorological, hydrological, and oceanographic operations. In 1 year, about 3.5 million observations are taken and 1.9 million forecasts and warnings issued. In addition, countless individual briefings and services are provided on a routine but unscheduled basis.

Within the framework of this report all of the operating functions and service programs of NWS are considered. Included are the meteorological program activities, the hydrologic forecast and service activities, as well as the oceanographic and climatological services. The Research and Development, Engineering and Technical Training areas are also described.

Appendices to this report include a listing of stations with identifiers, a tabular summary of facilities and service programs at each station, and a brief description of the administrative organization of NWS.

Pub. Oct. 73; 247p., U.S. Dept. Comm. NOAA, Nat. Weather Service, Silver Spring, Md.

Abstract provided by FDAA.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

16.0093, RE-DRAFT OF SEEKONK ZONING BY LAW, 15 NOVEMBER 1969

J. BLACKWELL, State Dept. of Community Affs., Boston, Massachusetts 02202

Abstract: Contents: Authority, purposes and validity; Zoning districts and boundaries; General provisions; Non-conforming buildings and uses; Rural residence districts; Suburban residence districts; Village residence districts; Business districts; Highway business districts; Industrial districts; Flood plain districts; Earth materials removal; Board of appeals; Amendments; Enforcement.

Pub. Jun. 69; 50p., NTIS No. PB-194 552: HC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0094, COLLABORATIVE RESEARCH ON NATURAL HAZARDS

R.W. KATES, Clark University, Graduate School, Worcester, Massachusetts 01610

The collaborative program of natural hazard research seeks to understand the ways in which man perceives extreme natural events and adjust to their hazards, to apply this knowledge towards reducing the social cost of these events, and to extend such understandings to the new complex of man-made environmental risks. A basic research paradigm has been developed: for any natural hazard, the research sought to 1) assess the extent of human occupancy by hazard zones, 2) identify the full range of possible human adjustments to the hazard, 3) study how men perceive and estimate the occur-

program special attention is directed (1) to insights and strategies developed in previous hazards and to other cultural settings; and (2) the existence of a 'Natural Hazard Syndrome' the similarities and differences in human adjustment to extreme geophysical events, biological hazards, environmental hazards, and common man-made hazards in modern society. Related to these major research goals is the need for encouraging new investigators, from other disciplines, developing new research and experimental methods, designing comparative studies, and preparing literature and research in new areas of investigation. This grant supports a three pronged effort at Clark University of Torrington, Vermont.

SUPPORTED BY U.S. Natl. Science Foundation

16.0095, COMPREHENSIVE PLAN - REDEMPTION - VILLAGE OF EAST AURORA TOWN OF AURORA, N.Y.

UNKNOWN, Aurora Planning Board, Aurora, N.Y.

Abstract: The resultant Comprehensive Plan for the Village of East Aurora, New York, includes proposed land use for the Village and Town; Street and Highway with emphasis on the reduction of through traffic in residential neighborhoods in the village; a special relation of surface water drainage, public sewerage, and land forms and soil types, with a timetable for implementation of alternative plans for residential subdivision; a Utility Facilities Plan with suggested park designs. The plan includes a section on discussion and actions concerned with regulatory measures and proposed amendments to the local zoning ordinance and a 'conservation sector' in the town.

Pub. Jun. 70; 123p., NTIS No. PB-192 382: HC \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0096, THE CHARLOTTE CONSORTIUM FOR URBAN DEVELOPMENT - VOLUME IIA - ANALYSIS OF MUNICIPAL ACTIVITIES - PUBLIC SAFETY SUBSYSTEM

UNKNOWN, Unknown Inst. or Indiv. Grant, North Carolina

Abstract: The report is from a USAC series project of the City of Charlotte, North Carolina, covering systems analysis through implementation and urban information systems. It contains a function of municipal activities comprising the police, fire, and mental control, and disaster planning and control. Each is described in terms of hierarchical functions, components, and processes. Described by flow charts and text, with cross references related to other subsystems.

Pub. Feb. 71; 620p., NTIS No. PB-208 487-02: HC \$0.95.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0097, THE POLICE DEPARTMENT IN NATURAL DISASTER OPERATIONS

J.M. BROOKS, Ohio State University, Disaster Center, Columbus, Ohio 43210

Abstract: The report describes the involvement

sequences of these adaptations to the authority structure, the decision-making process, and channels of communication are discussed. The relationship of the police to other organizations in emergency action is also elaborated.

Pub. Sep. 69: 85p., NTIS No. AD-707 937: HC \$3.00 MF \$0.65.

SUPPORTED BY No Formal Support Reported

16.0098, A PERSPECTIVE ON DISASTER PLANNING

R.R. DYNES, Ohio State University, Disaster Research Center, Columbus, Ohio 43210

Abstract: The report presents a perspective in disaster planning. The characteristics of disaster agents, and the kinds of demands and requirements they generate, are considered. This is followed by an examination of widely held misconceptions of how people and groups behave in disaster situations. A contrast is then made between community activities and processes in normal times and during emergencies. Next, the basic elements involved in the organized response of a community to a disaster are set forth. The report concludes with a systematic discussion of disaster planning, including weaknesses in typical disaster plans and strategies for bringing about community emergency planning.

Pub. Jun. 72: 98p., NTIS No. AD-750 293: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0099, THE WARNING SYSTEM IN DISASTER SITUATIONS - A SELECTIVE ANALYSIS

R.F. MCLUCKIE, Ohio State University, Disaster Research Center, Columbus, Ohio 43210

Abstract: In many ways warning can be the most important phase of the disaster response. Warning is thought of not just in terms of mechanical devices but in terms of psychological and sociological structures and processes. Warning is not only advance notification of the existence of danger but also information about what can be done to prevent, avoid, or minimize the danger. The characteristics of the disaster agent -- frequency, speed of onset, scope of impact, destructive potential, etc. -- affect the warning process. Before a warning message can be issued, threat data must be collected, collated, and evaluated. The report examines what is involved in these processes. Included among the factors influencing response are the socio-cultural framework, the historical setting, and the immediate ongoing social situation. The report contains a discussion of implications for nuclear catastrophe.

Pub. Jul. 70: 78p., NTIS No. AD-714 991: PC \$3.00 MF \$0.95.

SUPPORTED BY No Formal Support Reported

16.0100, ORGANIZATIONAL RESPONSES TO MAJOR COMMUNITY CRISES

E.L. QUARANTELLI, Ohio State University, School of Social Science, Columbus, Ohio 43212

There are three related aspects of this study which will conclude this year. 1) Some field work will be done primarily to fill in gaps in our data on hospital emergency services, rumor control centers, emergent groups, and radio and television stations (and possibly human relations units in police departments). 2) Considerable more time will be spent on data analysis. In part, we will finish up the aforementioned studies for which new data are being gathered. But we will also be

articles are being finished to appear in a special issue of *The American Behavioral Scientist* devoted to 'Issues of Organizational Involvement and Civil Disturbances.' About ten monographs will especially on organizational responses to emergencies. The theoretical model developed in this five year research and dealing with similarities in group activities in natural disturbances is to be detailed in a book.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & W.F. H.S.M.H.A.

16.0101, DISASTER RELIEF - DOMESTIC ACTION SPOTLIGHT

E.J. RUSH, U.S. Army, War College, Carlisle, PA 17013

Abstract: Disaster relief is examined as one of the Army, including Active Army, Army National Guard, and Army Reserve, to particularly demonstrate and develop domestic action capabilities and thereby gain Congressional support. The examination is based on the devastation wrought in the Commonwealth of Massachusetts and the State of New York by Tropical Storm Edith in 1972, and the disaster relief efforts of thousands of personnel from all three components following the storm to restore order out of chaos. Source documents include after action reports, letters, telegrams, memoranda, legal authorities, policy documents, and periodicals. The laws, regulations, and plans governing disaster relief are discussed. The devastation caused by the storm is followed by a detailed summary of the roles of various units. Problems faced by the Secretary of Defense and the Commanding General, First U.S. Army, along with the decisions, which are then assessed. Lessons learned by the National Guard units are also presented.

Pub. Mar. 73: 80p., NTIS No. AD-761 041: PC \$3.00 MF \$0.95.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0102, MYRTLE BEACH, S.C. - COMMUNITY DEVELOPMENT PLAN

UNKNOWN, State Planning & Grants Div., Carolina

Abstract: A comprehensive development plan for Myrtle Beach relative to the economy, population, goals, needs, constraints, existing land use, future land use, and within the area defined as the Myrtle Beach Planning Area.

Pub. Apr. 70: 155p., NTIS No. PB-192 352: PC \$3.00 MF \$0.65.

SUPPORTED BY U.S. Dept. of Housing & Urban Development

16.0103, THE WICHITA FALLS CONSORTIUM REPORT - VOLUME III - ANALYSIS OF MULTIPLE ACTIVITIES - SECTION IV - PUBLIC SAFETY

UNKNOWN, Unknown Inst. or Indiv. Grant, Texas

Abstract: The report is from a USAC series project in the City of Wichita Falls, covering activities from the analysis through implementation and evaluation of various public safety systems. The report discusses the public safety activities. It includes the results of a systems analysis of activities taking place in the Police Department.

16.0104, ENVIRONMENTAL GEOLOGIC ATLAS OF THE TEXAS COASTAL ZONE, GALVESTON-HOUSTON AREA
W.L. FISHER, Univ. of Texas, Bureau of Economic Geology, Austin, Texas 78712
Pub. 1972: 91p., No copy info. available.
Abstract provided by FDAA.
SUPPORTED BY No Formal Support Reported

16.0105, METROPOLITAN WATER SYSTEM OPERATION SUBSEQUENT TO NUCLEAR ATTACK OR NATURAL DISASTER

D.A. BROCK, Dallas Water Utilities Dept., Dallas, Texas
Abstract: The study develops methodology for creation of a plan for operation of a metropolitan water system subsequent to nuclear attack or natural disaster. Automatic digital computer water system simulation is used to determine the ultimate overall effect of damage to specific components. Vulnerability analyses are made as a mathematical model of the water system reacts automatically to hypothetical attack data supplied by the National Civil Defense Computer Center. Problems of unmanned water purification plant operation are noted. The need for and availability of electric power is considered.

Pub. May 70: 381p., NTIS No. Ad-711 956: HC \$3.00 MF \$0.65.

SUPPORTED BY No Formal Support Reported

16.0106, SOIL POLLUTION - EROSION EFFECTS IN SOIL UNKNOWN, U.S. Dept. of Defense, Defense Documentation Center, Alexandria, Virginia

Abstract: The bibliography contains 291 unclassified and unlimited citations of reports on the presumably damaging effects of erosion on the regolith. Erosion by wind, water, ice, avalanches, landslides, earthquakes, helicopter rotor downwash, exhaust gases, and other forces is represented. Procedures for the protection, stabilization, preservation, and restoration of earth materials exposed to erosion are included. Corporate Author: Monitoring Agency, Subject, Title, and Personal Author indexes are provided.

Pub. Jul. 73: 390p., NTIS No. AD-763 500. PC \$9.00 MF \$1.45.

D.E. PAULEY, Gantney & Jones Comm. Inc., Virginia 22042

Abstract: The objective of this study is to select desirable equipment that will enable broadcast the Defense Civil Preparedness Agency Radio Protection Program to rapidly restore broadcasting in the event of destruction of the regular antenna. Expedient antennas are proposed for AM and FM. Procurement specifications are presented. A plan for the construction of expedient antennas from available materials is included.

Pub. Nov. 73: 126., NTIS No. AD-775 831/1: \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0108, AREA-WIDE DISASTER RESPONSE PREPAREDNESS AND REGIONAL COUNCILS

R.J. MARSHAK, Human Sciences Research Inc., Virginia 22101

Abstract: The report is divided into three parts: the development of regional councils and the Process; a regional approach to preparedness organization which would allow the preparedness to utilize regional councils effectively; and planning requirements that would be posed by the region, with an indication of how a regional preparation would support such a contingency plan. Major recommendations of the report include: the funding of a professional planner or advisor to work with the Collegium and regional council; encouragement of regional councils to conduct projects as part of the A-95 PNRS; the funding, area-wide comprehensive preparedness plans; the preparation of crisis relocation planning within a comprehensive planning effort utilizing regional council; encourage multi-jurisdictional and multi-agency cooperation.

Pub. Feb. 74: 204p., NTIS No. AD-776 382/4: \$1.45.

SUPPORTED BY U.S. Dept. of Defense - Army

16.0109, BUILDING STANDARDS AND EARTHQUAKE HAZARD FOR THE PUGET SOUND BASIN

B. GONEN, Univ. of Washington, School of Engineering, Washington 98105

This report presents a historical record of the effects on structures of the two most recent earthquakes (1949 and 1965) in the Puget Sound area. It outlines the history and current state of building codes for earthquakes in the Puget Sound area, and compares regional activities that could aid material damage during future earthquakes in the Puget Sound area. The aim of this report is to provide a reference regional information relevant for earthquake-resistance in the Puget Sound Basin. Since structural effects are dissociated from ground effects, this study includes soil, geological and seismological effects for the

The 1949 earthquake is discussed in Chapter 2, the 1965 earthquake in Chapter 3. The history of building code changes in building-code ordinances for earthquakes within the Puget Sound region for the period through 1973 are reviewed in Chapter 4. The earthquake resistant design is discussed in Chapter

Pub May 74, 146p., Report SM 74-1; Div. of Structures & Mechanics, Dept. of Civil Engineering, Univ. of Wash., Seattle, Wash. 98195.

Abstract provided by FDAA.

SUPPORTED BY U.S. Natl. Science Foundation

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2.0003, 2.0005, 2.0010, 2.0013, 2.0019, 2.0021, 2.0024, 3.0002, 3.0019, 3.0024, 3.0025, 3.0049, 3.0155, 3.0156, 3.0157, 3.0159, 3.0160, 3.0219, 3.0221, 3.0235, 3.0237, 3.0238, 3.0259, 3.0275, 5.0029, 5.0031, 6.0006, 6.0021, 6.0022, 6.0036, 6.0056, 6.0070, 6.0081, 6.0103, 6.0104, 6.0182, 6.0207, 6.0289, 6.0290, 6.0341, 6.0359, 6.0391, 7.0012, 7.0016, 8.0002, 8.0004, 8.0005, 8.0007, 8.0016, 8.0020, 8.0021, 8.0022, 8.0023, 8.0029, 8.0057, 8.0058, 8.0059, 8.0060, 8.0061, 8.0062, 8.0063, 8.0064, 8.0065, 8.0066, 8.0068, 8.0069, 8.0075, 8.0084, 8.0085, 8.0086, 8.0087, 8.0088, 8.0089, 8.0090, 8.0091, 8.0092, 8.0093, 8.0094, 8.0095, 8.0096, 8.0097, 8.0098, 8.0099, 8.0100, 8.0101, 8.0102, 8.0103, 8.0104, 8.0105, 8.0106, 8.0107, 8.0108, 8.0109, 8.0110, 8.0111, 8.0112, 8.0113, 8.0114, 8.0115, 8.0116, 8.0117, 8.0118, 8.0119, 8.0120, 8.0121, 8.0122, 8.0123, 8.0124, 8.0125, 8.0126, 8.0127, 8.0128, 8.0129, 8.0130, 8.0131, 8.0132, 8.0133, 8.0134, 8.0135, 8.0136, 8.0137, 8.0138, 8.0139, 8.0140, 8.0141, 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8.0267, 8.0268, 8.0269, 8.0270, 8.0271, 8.0272, 8.0273, 8.0274, 8.0275, 8.0276, 8.0277, 8.0278, 8.0279, 8.0280, 8.0281, 8.0282, 8.0283, 8.0284, 8.0285, 8.0286, 8.0287, 8.0288, 8.0289, 8.0290, 8.0291, 8.0292, 8.0293, 8.0294, 8.0295, 8.0296, 8.0297, 8.0298, 8.0299, 8.0300, 8.0301, 8.0302, 8.0303, 8.0304, 8.0305, 8.0306, 8.0307, 8.0308, 8.0309, 8.0310, 8.0311, 8.0312, 8.0313, 8.0314, 8.0315, 8.0316, 8.0317, 8.0318, 8.0319, 8.0320, 8.0321, 8.0322, 8.0323, 8.0324, 8.0325, 8.0326, 8.0327, 8.0328, 8.0329, 8.0330, 8.0331, 8.0332, 8.0333, 8.0334, 8.0335, 8.0336, 8.0337, 8.0338, 8.0339, 8.0340, 8.0341, 8.0342, 8.0343, 8.0344, 8.0345, 8.0346, 8.0347, 8.0348, 8.0349, 8.0350, 8.0351, 8.0352, 8.0353, 8.0354, 8.0355, 8.0356, 8.0357, 8.0358, 8.0359, 8.0360, 8.0361, 8.0362, 8.0363, 8.0364, 8.0365, 8.0366, 8.0367, 8.0368, 8.0369, 8.0370, 8.0371, 8.0372, 8.0373, 8.0374, 8.0375, 8.0376, 8.0377, 8.0378, 8.0379, 8.0380, 8.0381, 8.0382, 8.0383, 8.0384, 8.0385, 8.0386, 8.0387, 8.0388, 8.0389, 8.0390, 8.0391, 8.0392, 8.0393, 8.0394, 8.0395, 8.0396, 8.0397, 8.0398, 8.0399, 8.0400, 8.0401, 8.0402, 8.0403, 8.0404, 8.0405, 8.0406, 8.0407, 8.0408, 8.0409, 8.0410, 8.0411, 8.0412, 8.0413, 8.0414, 8.0415, 8.0416, 8.0417, 8.0418, 8.0419, 8.0420, 8.0421, 8.0422, 8.0423, 8.0424, 8.0425, 8.0426, 8.0427, 8.0428, 8.0429, 8.0430, 8.0431, 8.0432, 8.0433, 8.0434, 8.0435, 8.0436, 8.0437, 8.0438, 8.0439, 8.0440, 8.0441, 8.0442, 8.0443, 8.0444, 8.0445, 8.0446, 8.0447, 8.0448, 8.0449, 8.0450, 8.0451, 8.0452, 8.0453, 8.0454, 8.0455, 8.0456, 8.0457, 8.0458, 8.0459, 8.0460, 8.0461, 8.0462, 8.0463, 8.0464, 8.0465, 8.0466, 8.0467, 8.0468, 8.0469, 8.0470, 8.0471, 8.0472, 8.0473, 8.0474, 8.0475, 8.0476, 8.0477, 8.0478, 8.0479, 8.0480, 8.0481, 8.0482, 8.0483, 8.0484, 8.0485, 8.0486, 8.0487, 8.0488, 8.0489, 8.0490, 8.0491, 8.0492, 8.0493, 8.0494, 8.0495, 8.0496, 8.0497, 8.0498, 8.0499, 8.0500, 8.0501, 8.0502, 8.0503, 8.0504, 8.0505, 8.0506, 8.0507, 8.0508, 8.0509, 8.0510, 8.0511, 8.0512, 8.0513, 8.0514, 8.0515, 8.0516, 8.0517, 8.0518, 8.0519, 8.0520, 8.0521, 8.0522, 8.0523, 8.0524, 8.0525, 8.0526, 8.0527, 8.0528, 8.0529, 8.0530, 8.0531, 8.0532, 8.0533, 8.0534, 8.0535, 8.0536, 8.0537, 8.0538, 8.0539, 8.0540, 8.0541, 8.0542, 8.0543, 8.0544, 8.0545, 8.0546, 8.0547, 8.0548, 8.0549, 8.0550, 8.0551, 8.0552, 8.0553, 8.0554, 8.0555, 8.0556, 8.0557, 8.0558, 8.0559, 8.0560, 8.0561, 8.0562, 8.0563, 8.0564, 8.0565, 8.0566, 8.0567, 8.0568, 8.0569, 8.0570, 8.0571, 8.0572, 8.0573, 8.0574, 8.0575, 8.0576, 8.0577, 8.0578, 8.0579, 8.0580, 8.0581, 8.0582, 8.0583, 8.0584, 8.0585, 8.0586, 8.0587, 8.0588, 8.0589, 8.0590, 8.0591, 8.0592, 8.0593, 8.0594, 8.0595, 8.0596, 8.0597, 8.0598, 8.0599, 8.0600, 8.0601, 8.0602, 8.0603, 8.0604, 8.0605, 8.0606, 8.0607, 8.0608, 8.0609, 8.0610, 8.0611, 8.0612, 8.0613, 8.0614, 8.0615, 8.0616, 8.0617, 8.0618, 8.0619, 8.0620, 8.0621, 8.0622, 8.0623, 8.0624, 8.0625, 8.0626, 8.0627, 8.0628, 8.0629, 8.0630, 8.0631, 8.0632, 8.0633, 8.0634, 8.0635, 8.0636, 8.0637, 8.0638, 8.0639, 8.0640, 8.0641, 8.0642, 8.0643, 8.0644, 8.0645, 8.0646, 8.0647, 8.0648, 8.0649, 8.0650, 8.0651, 8.0652, 8.0653, 8.0654, 8.0655, 8.0656, 8.0657, 8.0658, 8.0659, 8.0660, 8.0661, 8.0662, 8.0663, 8.0664, 8.0665, 8.0666, 8.0667, 8.0668, 8.0669, 8.0670, 8.0671, 8.0672, 8.0673, 8.0674, 8.0675, 8.0676, 8.0677, 8.0678, 8.0679, 8.0680, 8.0681, 8.0682, 8.0683, 8.0684, 8.0685, 8.0686, 8.0687, 8.0688, 8.0689, 8.0690, 8.0691, 8.0692, 8.0693, 8.0694, 8.0695, 8.0696, 8.0697, 8.0698, 8.0699, 8.0700, 8.0701, 8.0702, 8.0703, 8.0704, 8.0705, 8.0706, 8.0707, 8.0708, 8.0709, 8.0710, 8.0711, 8.0712, 8.0713, 8.0714, 8.0715, 8.0716, 8.0717, 8.0718, 8.0719, 8.0720, 8.0721, 8.0722, 8.0723, 8.0724, 8.0725, 8.0726, 8.0727, 8.0728, 8.0729, 8.0730, 8.0731, 8.0732, 8.0733, 8.0734, 8.0735, 8.0736, 8.0737, 8.0738, 8.0739, 8.0740, 8.0741, 8.0742, 8.0743, 8.0744, 8.0745, 8.0746, 8.0747, 8.0748, 8.0749, 8.0750, 8.0751, 8.0752, 8.0753, 8.0754, 8.0755, 8.0756, 8.0757, 8.0758, 8.0759, 8.0760, 8.0761, 8.0762, 8.0763, 8.0764, 8.0765, 8.0766, 8.0767, 8.0768, 8.0769, 8.0770, 8.0771, 8.0772, 8.0773, 8.0774, 8.0775, 8.0776, 8.0777, 8.0778, 8.0779, 8.0780, 8.0781, 8.0782, 8.0783, 8.0784, 8.0785, 8.0786, 8.0787, 8.0788, 8.0789, 8.0790, 8.0791, 8.0792, 8.0793, 8.0794, 8.0795, 8.0796, 8.0797, 8.0798, 8.0799, 8.0800, 8.0801, 8.0802, 8.0803, 8.0804, 8.0805, 8.0806, 8.0807, 8.0808, 8.0809, 8.0810, 8.0811, 8.0812, 8.0813, 8.0814, 8.0815, 8.0816, 8.0817, 8.0818, 8.0819, 8.0820, 8.0821, 8.0822, 8.0823, 8.0824, 8.0825, 8.0826, 8.0827, 8.0828, 8.0829, 8.0830, 8.0831, 8.0832, 8.0833, 8.0834, 8.0835, 8.0836, 8.0837, 8.0838, 8.0839, 8.0840, 8.0841, 8.0842, 8.0843, 8.0844, 8.0845, 8.0846, 8.0847, 8.0848, 8.0849, 8.0850, 8.0851, 8.0852, 8.0853, 8.0854, 8.0855, 8.0856, 8.0857, 8.0858, 8.0859, 8.0860, 8.0861, 8.0862, 8.0863, 8.0864, 8.0865, 8.0866, 8.0867, 8.0868, 8.0869, 8.0870, 8.0871, 8.0872, 8.0873, 8.0874, 8.0875, 8.0876, 8.0877, 8.0878, 8.0879, 8.0880, 8.0881, 8.0882, 8.0883, 8.0884, 8.0885, 8.0886, 8.0887, 8.0888, 8.0889, 8.0890, 8.0891, 8.0892, 8.0893, 8.0894, 8.0895, 8.0896, 8.0897, 8.0898, 8.0899, 8.0900, 8.0901, 8.0902, 8.0903, 8.0904, 8.0905, 8.0906, 8.0907, 8.0908, 8.0909, 8.0910, 8.0911, 8.0912, 8.0913, 8.0914, 8.0915, 8.0916, 8.0917, 8.0918, 8.0919, 8.0920, 8.0921, 8.0922, 8.0923, 8.0924, 8.0925, 8.0926, 8.0927, 8.0928, 8.0929, 8.0930, 8.0931, 8.0932, 8.0933, 8.0934, 8.0935, 8.0936, 8.0937, 8.0938, 8.0939, 8.0940, 8.0941, 8.0942, 8.0943, 8.0944, 8.0945, 8.0946, 8.0947, 8.0948, 8.0949, 8.0950, 8.0951, 8.0952, 8.0953, 8.0954, 8.0955, 8.0956, 8.0957, 8.0958, 8.0959, 8.0960, 8.0961, 8.0962, 8.0963, 8.0964, 8.0965, 8.0966, 8.0967, 8.0968, 8.0969, 8.0970, 8.0971, 8.0972, 8.0973, 8.

12.0016, 12.0020, 12.0021, 12.0022, 12.0023, 12.0024,
12.0025, 12.0026, 12.0027, 12.0028, 12.0030, 12.0031,
12.0036, 12.0037, 12.0039, 12.0041, 13.0004, 13.0005,
13.0007, 13.0008, 13.0020, 13.0022, 13.0023, 13.0024,
13.0025, 15.0001, 15.0017, 15.0026, 15.0027, 15.0029,
15.0036, 16.0045, 16.0046, 16.0066, 16.0067, 16.0068,
16.0069, 16.0070, 16.0071, 16.0072, 16.0090, 16.0091,
16.0092.

U.S. Dept. of Defense - Air Force

3.0070, 3.0145, 3.0146, 3.0239, 3.0241, 3.0248, 3.0249,
3.0250, 3.0258, 5.0030, 8.0071, 9.0017, 9.0056, 12.0003,
12.0029.

U.S. Dept. of Defense - Army

1.0004, 1.0007, 1.0013, 3.0005, 3.0031, 3.0034, 3.0036,
3.0065, 3.0066, 3.0067, 3.0074, 3.0187, 3.0203, 3.0217,
3.0232, 3.0233, 3.0234, 3.0242, 3.0254, 3.0267, 4.0002,
4.0003, 5.0023, 6.0017, 6.0032, 6.0033, 6.0037, 6.0038,
6.0053, 6.0054, 6.0086, 6.0095, 6.0096, 6.0097, 6.0098,
6.0099, 6.0100, 6.0101, 6.0108, 6.0109, 6.0110, 6.0111,
6.0116, 6.0117, 6.0118, 6.0119, 6.0120, 6.0121, 6.0141,
6.0142, 6.0152, 6.0167, 6.0172, 6.0173, 6.0174, 6.0247,
6.0257, 6.0312, 6.0313, 6.0314, 6.0315, 6.0320, 6.0358,
6.0405, 8.0003, 8.0013, 8.0014, 8.0017, 8.0019, 8.0025,
8.0028, 8.0030, 8.0031, 8.0032, 8.0033, 8.0034, 8.0035,
8.0036, 8.0037, 8.0038, 8.0039, 8.0040, 8.0041, 8.0042,
8.0043, 8.0044, 8.0045, 8.0046, 8.0047, 8.0048, 8.0049,
8.0050, 8.0051, 8.0055, 8.0056, 8.0072, 8.0073, 8.0119,
8.0134, 9.0003, 9.0021, 9.0054, 10.0009, 10.0010,
10.0030, 12.0040, 13.0001, 13.0009, 13.0010, 13.0019,
13.0026, 13.0027, 13.0028, 13.0029, 15.0004, 15.0006,
15.0007, 15.0009, 15.0010, 15.0011, 15.0015, 15.0019,
15.0021, 16.0007, 16.0008, 16.0026, 16.0027, 16.0033,
16.0037, 16.0044, 16.0049, 16.0052, 16.0053, 16.0057,
16.0059, 16.0060, 16.0078, 16.0079, 16.0085, 16.0086,
16.0087, 16.0098, 16.0101, 16.0107, 16.0108.

U.S. Dept. of Defense - D.A.R.P.A.

3.0104, 3.0263, 8.0054.

U.S. Dept. of Defense - D.S.A.

16.0106.

U.S. Dept. of Defense - Navy

2.0014, 3.0007, 3.0044, 3.0058, 3.0080, 5.0012, 8.0008,
8.0052, 8.0053, 8.0070, 8.0080, 8.0081, 8.0082, 8.0103,
8.0117, 8.0118, 8.0121, 8.0136, 9.0004, 9.0036, 9.0063,
10.0002, 10.0025, 13.0002, 13.0016, 15.0014, 15.0022,
15.0024, 15.0025, 16.0010.

U.S. Dept. of Hlth. Ed. & Wel.

6.0014, 6.0398.

U.S. Dept. of Hlth. Ed. & Wel. - A.D.M.H.A.

6.0003, 16.0020.

U.S. Dept. of Hlth. Ed. & Wel. - H.S.M.H.A.

6.0008, 6.0009, 6.0010, 6.0011, 16.0002, 16.0006,
16.0011, 16.0018, 16.0100.

U.S. Dept. of Housing & Urban Development

1.0003, 2.0002, 3.0011, 3.0021, 3.0047, 3.0069, 3.0149,
3.0158, 3.0162, 3.0196, 3.0218, 3.0269, 3.0284, 4.0001,
5.0026, 6.0002, 6.0005, 6.0024, 6.0025, 6.0026, 6.0027,
6.0028, 6.0029, 6.0045, 6.0046, 6.0047, 6.0072, 6.0087,
6.0127, 6.0128, 6.0133, 6.0148, 6.0158, 6.0159, 6.0160,
6.0178, 6.0179, 6.0181, 6.0192, 6.0231, 6.0236, 6.0245,
6.0253, 6.0258, 6.0260, 6.0262, 6.0268, 6.0283, 6.0284,
6.0286, 6.0295, 6.0307, 6.0308, 6.0329, 6.0330, 6.0332,
6.0333, 6.0340, 6.0352, 6.0354, 6.0362, 6.0363, 6.0369,
6.0380, 6.0381, 6.0385, 7.0009, 8.0001, 8.0010, 8.0015,
8.0018, 8.0079, 9.0007, 9.0026, 10.0003, 10.0033,
11.0001, 12.0006, 12.0011, 13.0003, 14.0001, 14.0003.

U.S. Dept. of Interior - Bu. Reclamation

1.0008, 2.0006, 2.0008, 2.0009, 2.0012, 3.0053,
3.0173, 3.0183, 4.0007, 6.0171, 6.0183, 9.0008, 9.

U.S. Dept. of Interior - Bureau of Mines

6.0015, 6.0040, 9.0009, 10.0005, 10.0006,
10.0022, 10.0023, 10.0024.

U.S. Dept. of Interior - Geological Survey

1.0010, 2.0018, 3.0006, 3.0020, 3.0039, 3.0050,
3.0052, 3.0057, 3.0100, 3.0105, 3.0106, 3.0107,
3.0109, 3.0110, 3.0111, 3.0112, 3.0113, 3.0114,
3.0116, 3.0117, 3.0118, 3.0119, 3.0120, 3.0121,
3.0123, 3.0124, 3.0125, 3.0126, 3.0127, 3.0128,
3.0130, 3.0131, 3.0132, 3.0133, 3.0134, 3.0135,
3.0164, 3.0165, 3.0166, 3.0167, 3.0168, 3.0169,
3.0172, 3.0174, 3.0175, 3.0176, 3.0177, 3.0178,
3.0180, 3.0181, 3.0182, 3.0184, 3.0185, 3.0197,
3.0243, 4.0004, 4.0005, 4.0006, 6.0020, 6.0023,
6.0039, 6.0048, 6.0049, 6.0058, 6.0062, 6.0063,
6.0068, 6.0069, 6.0071, 6.0075, 6.0079, 6.0082,
6.0091, 6.0093, 6.0094, 6.0102, 6.0106, 6.0114,
6.0129, 6.0134, 6.0135, 6.0136, 6.0138, 6.0139,
6.0143, 6.0147, 6.0149, 6.0156, 6.0161, 6.0164,
6.0168, 6.0169, 6.0176, 6.0180, 6.0184, 6.0185,
6.0187, 6.0188, 6.0193, 6.0210, 6.0211, 6.0215,
6.0220, 6.0221, 6.0230, 6.0233, 6.0234, 6.0244,
6.0249, 6.0250, 6.0251, 6.0254, 6.0255, 6.0256,
6.0274, 6.0275, 6.0276, 6.0277, 6.0278, 6.0279,
6.0281, 6.0282, 6.0287, 6.0296, 6.0297, 6.0303,
6.0305, 6.0310, 6.0311, 6.0316, 6.0317, 6.0318,
6.0325, 6.0326, 6.0331, 6.0342, 6.0343, 6.0344,
6.0357, 6.0364, 6.0365, 6.0366, 6.0370, 6.0371,
6.0373, 6.0374, 6.0375, 6.0376, 6.0377, 6.0382,
6.0384, 6.0386, 6.0389, 6.0392, 6.0394, 6.0395,
6.0401, 6.0403, 6.0404, 6.0407, 6.0408, 6.0409,
6.0415, 8.0027, 8.0133, 9.0001, 9.0002, 9.0027,
9.0029, 9.0030, 9.0031, 9.0032, 9.0033, 9.0034,
9.0041, 9.0042, 9.0043, 9.0044, 9.0045, 9.0046,
9.0049, 10.0004, 10.0011, 10.0012, 10.0013,
10.0016, 10.0017, 10.0018, 10.0019, 10.0020,
10.0029, 13.0011, 13.0013, 13.0014, 13.0017,
14.0002, 14.0004, 14.0006, 14.0007, 14.0008,
14.0011, 14.0012, 14.0013, 14.0014, 15.0013,
15.0037, 15.0039, 16.0054, 16.0055, 16.0056,
16.0075.

U.S. Dept. of Interior - O. Wtr. Res. Reh.

2.0015, 2.0023, 3.0102, 6.0013, 6.0018, 6.0073,
6.0076, 6.0113, 6.0137, 6.0144, 6.0153, 6.0154,
6.0166, 6.0175, 6.0191, 6.0238, 6.0246, 6.0267,
6.0291, 6.0292, 6.0293, 6.0306, 6.0322, 6.0334,
6.0360, 6.0378, 6.0406, 10.0001, 14.0015,
15.0033, 15.0038.

U.S. Dept. of Interior - O.W.R.T.

2.0001, 2.0016, 5.0022, 5.0044, 6.0004, 6.0007,
6.0051, 6.0066, 6.0078, 6.0080, 6.0088, 6.0089,
6.0105, 6.0107, 6.0122, 6.0123, 6.0124, 6.0126,
6.0132, 6.0146, 6.0150, 6.0151, 6.0237, 6.0239,
6.0241, 6.0242, 6.0243, 6.0266, 6.0269, 6.0270,
6.0273, 6.0285, 6.0288, 6.0294, 6.0300, 6.0301,
6.0321, 6.0324, 6.0328, 6.0335, 6.0338, 6.0339,
6.0353, 6.0355, 6.0361, 6.0379, 6.0387, 6.0390,
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U.S. Dept. of Justice

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SUPPORTING AGENCY INDEX

U.S. Dept. of Transportation - Coast Guard
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U.S. Dept. of Transportation - N.H.T.S.A
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U.S. Dept. of Transportation - N.T.S.B.
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U.S. Dept. of Transportation - Off. Sec.
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U.S. Environ. Protect. Agency - O.R.M
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U.S. Executive Office - O.E.P.
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U.S. Executive Office - O.S.T.
3.0200.

U.S. Natl. Aero. & Space Adm.

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U.S. Natl. Science Foundation

1.0005, 2.0004, 3.0008, 3.0009, 3.0016, 3.0023, 3.0026,
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U.S. Tennessee Valley Auth.

6.0367, 6.0368

U.S. Veterans Administration

3.0189, 3.0201.

U.S. Water Resources Council - Wash., D.C.

6.0223, 6.0224, 6.0225, 6.0226, 6.0227, 6.0228.

University of Alabama

6.0162.

University of California

3.0003, 3.0029, 3.0030, 3.0033, 3.0035, 3.0077, 3.0081, 3.0082, 3.0083, 3.0084, 3.0089, 3.0091, 3.0092, 3.0093, 3.0095, 3.0098, 3.0099.

University of Hawaii

6.0077.

University of Illinois

3.0059, 3.0207, 3.0209, 3.0213, 6.0264, 8.012, 0035.

University of Southern Miss. - Hattiesburg

4.0009.

University of Texas

9.0023.

Virginia Polytechnic Inst. - Blacksburg

6.0012.

Washington State Government - Olympia

1.0001, 1.0002, 1.0006, 6.0402

Wyoming State Government - Cheyenne

6.0189, 11.0008.

SUPPORTING ORGANIZATION ADDRESSES

This list provides more complete address information of supporting organizations than appears for each project in the Disaster Types section.

Alabama State Government
Montgomery, AL 36104

Auburn University at Montgomery
Atlanta Highway
Montgomery, AL 36109

California Institute of Technology
Pasadena, CA 91109

California State Government
State Capitol
Tenth at L, North
Sacramento, CA 95814

Chicago City Government
City Hall
121 N LaSalle Street
Chicago, IL 60602

Colorado State University
Fort Collins, CO 80521

Florida State Government
Tallahassee, FL 32301

Illinois State Government
State Capitol
State Capitol Complex
Springfield, IL 62706

Iowa State Government
Des Moines, IA 50318

Kentucky State Government
Frankfort, KY 40601

Los Angeles County Government
City Hall
200 N. Spring Street
Los Angeles, CA 90012

Michigan State Government

Mississippi R&D Center
Jackson, MS 39205

Montana State University
Bozeman, MT 59715

National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, DC 20418

National Concrete & Masonry
Association
1800 N. Kent Street
Arlington, VA 22209

Nevada State Government
Carson City, NV 89701

New Jersey State Government
Trenton City Hall
East State Street
Trenton, NJ 08608

New York Ocean Science
Laboratory
Montauk, NY 11954

New York State Government
New York State Attorney General
Capitol
Albany, NY 12224

North Dakota State Government
Bismark, ND 58501

Ohio State Government
State Office Building
65 S Front Street
Columbus, OH 43215

Ohio State University
400 Lincoln Tower
Columbus, OH 43210

Pennsylvania State University
201 Old Main
University Park, PA 16802

R. W. Johnson Foundation
New Brunswick, NJ 08902

Riverside County Government
Court House
4050 Main Street
Riverside, CA 92501

Salt Lake City Government
Salt Lake, City UT 84101

Texas A&M University System
College Station, TX 77843

Texas State Government
U.S. Courthouse
200 W. 8th Street
Austin, TX 78701

Texas Technological University
Lubbock, TX 79409

U.S. Atomic Energy Commission
Office of Information Services
Washington, DC 20545

U.S. Department of Agriculture
14th & Independence Avenue, S
Washington, DC 20250

U.S. Department of Agriculture
Cooperative State Research Ser
14th & Independence Avenue, S
Washington, DC 20250

U.S. Department of Agriculture

U.S. Department of Commerce
Environmental Science Services
Administration
(See Commerce, NOAA)

U.S. Department of Commerce
Economic Development
Administration
14th Street between Constitution
Avenue & E Street, N.W.
Washington, DC 20230

U.S. Department of Commerce
Maritime Administration
14th Street between Constitution
Avenue & E Street, N.W.
Washington, DC 20235

U.S. Department of Commerce
National Oceanic & Atmospheric
Administration
6010 Executive Boulevard
Rockville, MD 20852

U.S. Department of Commerce
National Bureau of Standards
Washington, DC 20234

U.S. Department of Defense
Air Force
The Pentagon
Washington, DC 20330

U.S. Department of Defense
Army
The Pentagon
Washington, DC 20310

U.S. Department of Defense
Defense Advanced Research
Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209

U.S. Department of Defense
Defense Supply Agency
Defense Documentation Center
Cameron Station
Alexandria, VA 22314

U.S. Department of
Health, Education, & Welfare
Alcohol, Drug Abuse & Mental
Health Administration
5600 Fishers Lane
Rockville, MD 20852

U.S. Department of
Health, Education, & Welfare
Health Services & Mental
Health Administration
U.S. Public Health Service
5600 Fishers Lane
Rockville, MD 20852

U.S. Department of
Health, Education, & Welfare
330 Independence Avenue, S.W.
Washington, DC 20201

U.S. Department of Housing &
Urban Development
451 - 7th Street, S.W.
Washington, DC 20410

U.S. Federal Disaster Assistance
Administration
DHUD Building
Room B-133 Mail Room
451 - 7th Street, S.W.
Washington, DC 20410

U.S. Department of the Interior
Bureau of Reclamation
C Street Between 18th &
19th Streets, N.W.
Washington, DC 20240

U.S. Department of the Interior
Bureau of Mines
C Street between 18th &
19th Streets, N.W.
Washington, DC 20240

U.S. Department of the Interior
Geological Survey
12201 Sunrise Valley Drive
Reston, VA 22092

U.S. Department of the Interior
Office of Water Resources Research
(See Interior, OWRP)

Washington, DC 20240
U.S. Department of Justice
Constitution Avenue &
10th Street, N.W.
Washington, DC 20530

U.S. Department of Transportation
Coast Guard
400 - 7th Street, S.W.
Washington, DC 20590

U.S. Department of Transportation
Federal Highway Administration
400 - 7th Street, S.W.
Washington, DC 20590

U.S. Department of Transportation
National Highway Traffic
Safety Administration
400 - 7th Street, S.W.
Washington, DC 20590

U.S. Department of Transportation
National Transportation
Safety Board
400 - 7th Street, S.W.
Washington, DC 20590

U.S. Department of Transportation
Office of the Secretary
400 - 7th Street, S.W.
Washington, DC 20590

U.S. Environmental Protection
Agency
Office of Resources Management
401 M Street, S.W.
Washington, DC 20460

U.S. Executive Office of the
President
Office of Emergency Preparedness
(See HUD, FDAA)

U.S. Executive Office of the
President
Office of Science & Technology
(See NSF, OSTP)

SUPPORTING ORGANIZATION ADDRESSES

U.S. National Aeronautics &
Space Administration
400 Maryland Avenue, S.W.
Washington, DC 20546

U.S. National Science Foundation
1800 G Street, N.W.
Washington, DC 20550

U.S. National Science Foundation
Office of Science & Technology
Policy
1800 G Street, N.W.
Washington, DC 20550

U.S. Tennessee Valley Authority
New Sprinkle Building
Knoxville, TN 37902

U.S. Veterans Administration
810 Vermont Avenue, N.W.
Washington, DC 20420

U.S. Water Resources Council
2120 I. Street, N.W.
Washington, DC 20037

University of Alabama
University, AL 35486

University of California
Central Office
220 University Avenue
Berkeley, CA 94720

University of Illinois
805 W. Pennsylvania A
Urbana, IL 61801

University of Southern
Southern Station Box
Hattiesburg, MS 3940

University of Texas
601 Colorado Street
Austin, TX 78701

Washington State Gov
Olympia, WA 98501

Wyoming State Govern
Cheyenne, WY 82001

SUPPORTING ORGANIZATION

AVALANCHES

U.S. DEPT. OF AGRICULTURE

1.0012 PHYSICAL PROPERTIES OF ALPINE SNOW AS RELATED TO WEATHER AND AVALANCHE CONDITIONS

M. MARTINELLI, U.S. Dept. of Agriculture, Rocky Mtn. For. & Rg. Ex. Sta.

U.S. DEPT. OF AGRICULTURE - F.S.

1.0011 WATER YIELD IMPROVEMENT AND AVALANCHE HAZARD PREDICTION IN ALPINE AREAS OF THE ROCKY MOUNTAINS

M. MARTINELLI, Colorado State University, U.S.D.A. Rocky Mtn. For. Sta.

U.S. DEPT. OF DEFENSE - ARMY

1.0004 ACOUSTIC EMISSION AND RELATED PROPERTIES OF SNOW APPLIED TO THE DETERMINATION OF SLAB AVALANCHE INITIATION 11042-EN

C.C. BRADLEY, Montana State University, School of Letters

1.0007 PUGET PEAK AVALANCHE, ALASKA

M.C. HOYER, Arizona State University, School of Liberal Arts

1.0013 SNOW PACK STABILITY INDICES RELATIVE TO THE CLIMAX AVALANCHE

C.C. BRADLEY, Montana State University, School of Letters

U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

1.0003 URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORD, State Div. of Mines & Geology

U.S. DEPT. OF INTERIOR - BU. RECLAMATION

1.0008 DEVELOPMENT OF METHODOLOGY FOR EVALUATION AND PREDICTION OF AVALANCHE HAZARD IN THE SAN JUAN MOUNTAINS OF COLORADO

J.D. IVES, Univ. of Colorado, Inst. of Arctic & Alpine Res.

U.S. DEPT. OF TRANSPORTATION - F.H.A.

1.0014 AVALANCHE CONTROL IMPLEMENTATION STUDY

E. LACHAPPELLE, State Dept. of Highways

U.S. NATL. AERO. & SPACE ADM.

1.0009 THERMAL SURVEILLANCE OF ACTIVE VOLCANOES

J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey

U.S. NATL. SCIENCE FOUNDATION

1.0005 ACOUSTIC EMISSION AND RELATED PROPERTIES OF SNOW APPLIED TO THE DETERMINATION OF SLAB AVALANCHE INITIATION

C.C. BRADLEY, Montana State University, Graduate School

WASHINGTON STATE GOVERNMENT - OLYMPIA

1.0001 AVALANCHE STUDIES, 1971-1972

E.R. LACHAPPELLE, State Dept. of Highways

1.0002 NORTH CASCADES HIGHWAY SR-20 AVALANCHE ATLAS

E.R. LACHAPPELLE, Univ. of Washington, School of Arts

1.0006 AVALANCHES ON THE NORTH CASCADES HIGHWAY (SR-20) - SUMMARY REPORT

E.R. LACHAPPELLE, State Dept. of Highways

DROUGHTS

ILLINOIS STATE GOVERNMENT - SPRINGFIELD

2.0011 DROUGHT CLIMATOLOGY OF ILLINOIS

F.A. HUFF, State Water Survey

NEVADA STATE GOVERNMENT - CARSON CITY

2.0017 ECONOMIC EVALUATION OF USE AND DEVELOPMENT OF WATER AND LAND RESOURCES

H.C. LITTLE, Univ. of Nevada, Agricultural Experiment Sta.

NORTH DAKOTA STATE GOVERNMENT - BISMARCK

PENNSYLVANIA STATE UNIVERSITY

2.0007 HYDROLOGIC SYSTEMS MODELING AND SIMULATION

G. ARON, Penn. State University, Inst. Res. Land & Wtr. Resour.

U.S. DEPT. OF AGRICULTURE - C.S.R.S.

2.0022 DEVELOPMENT OF RAINFALL DEFICIENCY INDEX FOR PUERTO RICO

M. CAPIEL, Univ. of Puerto Rico, Agricultural Experiment Sta.

U.S. DEPT. OF COMMERCE - N.O.A.A.

2.0003 CENTRAL FLORIDA SEEDING PROJECT

J.D. MCFADDEN, U.S. Dept. of Commerce, Research Flight Facility

2.0005 JOINT FEDERAL-STATE CUMULUS SEEDING PROGRAM FOR MITIGATION OF 1971 SOUTH FLORIDA DROUGHT

J. SIMPSON, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin

2.0010 FLORIDA CUMULUS SEEDING EXPERIMENT FOR DROUGHT MITIGATION, APRIL-MAY 1971

W.L. WOODLEY, U.S. Dept. of Commerce, Environ. Research Laboratories

2.0013 DROUGHT IN KANSAS

M.J. BROWN, Kansas State University, Agricultural Experiment Sta.

2.0019 EROSION AND DEPOSITION IN THE SOUNDS AND ESTUARIES OF THE NORTH CAROLINA COAST

R.L. INGRAM, Univ. of North Carolina, School of Arts

2.0021 ALTERNATIVE ADJUSTMENTS TO NATURAL HAZARDS

D.G. AREY, Univ. of Pittsburgh, Graduate School

2.0024 METEOROLOGICAL DROUGHT IN TENNESSEE

J.V. VAIKSNORAS, U.S. Dept. of Commerce, Natl. Weather Service

U.S. DEPT. OF DEFENSE - NAVY

2.0014 BEACHES AND GROUND WATER OF CAPE SABLE, FLORIDA, DURING EXTREME DROUGHT

R.J. RUSSELL, Louisiana State Univ. Systems, Coastal Studies Institute

U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

2.0002 URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology

U.S. DEPT. OF INTERIOR - BU. RECLAMATION

2.0008 PROJECT ARID DROP, A SUMMARY OF CLOUD SEEDING ACTIVITIES IN A CONDUCTED BY ATMOSPHERICS INC (ABBREV)

T.J. HENDERSON, Atmospherics Incorporated

2.0009 HYGROSCOPIC SEEDING IN OKLAHOMA VOLUME I

P.B. MACCREADY, Flight Test Research Inc

2.0012 POTENTIAL OF PRECIPITATION MODIFICATION IN MODERATE TO SEVERE DROUGHTS

F.A. HUFF, State Water Survey

U.S. DEPT. OF INTERIOR - GEOLOGICAL SURVEY

2.0018 THE DETERMINATION OF THE FREQUENCY OF DROUGHT FLOWS OF VARYING DURATION AND SEVERITY - NEW JERSEY

E.G. MILLER, U.S. Dept. of the Interior, Geological Survey

U.S. DEPT. OF INTERIOR - O. WTR. RESOURCES DIV.

2.0015 SEVERITY AND FREQUENCY OF DROUGHTS IN MISSISSIPPI

J.C. MCWHORTER, Mississippi St. University, Agriculture

2.0023 DROUGHT PROBABILITIES IN TENNESSEE

W.L. PARKS, Univ. of Tennessee, School of Agriculture

U.S. DEPT. OF INTERIOR - O.W.R. DIV.

2.0001 STUDY OF SEAWATER DESALTING PLANT WATER SUPPLY FOR NEW YORK CITY

S.L. SCHEFFER, Parsons Jurden Corporation

2.0016 NEBRASKA DROUGHTS - A STUDY OF PAST CHRONOLOGICAL AND SPATIAL PATTERNS WITH IMPLICATIONS FOR THE FUTURE

M.P. LAWSON, Univ. of Nebraska, School of Agriculture

U.S. NATL. SCIENCE FOUNDATION

2.0004 STUDIES OF URBAN EFFECTS ON CLIMATE AND SEVERE WEATHER

S.A. CHANGNON, Univ. of Illinois, State Water Resources Division

EARTHQUAKES

CALIFORNIA INST. OF TECHNOLOGY - PA

3.0001 EARTHQUAKES AND INSURANCE

UNKNOWN, Calif. Inst. of Technology, Center for Prev. Disaster

3.0041 EARTHQUAKE RESPONSE OF BUILDINGS AND DIAPHRAGM SYSTEMS

J. BIELAK, Calif. Inst. of Technology, Earthquake Res. Lab.

3.0045 DYNAMIC ANALYSIS OF COMPOSITE

3.0140 EARTHQUAKES AND INSURANCE - ERA CONFERENCE 2-3 APRIL, 1973

J.C. FULTON, Calif. Inst. of Technology, Center For Res. Prev. Disaster

3.0141 MODAL COUPLING AND EARTHQUAKE RESPONSE OF TALL BUILDINGS

J.B. HOERNER, Calif. Inst. of Technology, Earthquake Engin. Res. Lab.

3.0144 FORCED VIBRATION OF A 22-STORY STEEL FRAME BUILDING

P.C. JENNINGS, Calif. Inst. of Technology, Earthquake Engin. Res. Lab.

CALIFORNIA STATE GOVERNMENT - SACRAMENTO

3.0046 MEASUREMENT OF DYNAMIC CHARACTERISTICS OF SWITCHYARD EQUIPMENT

A.E. ESKEI, State Dept. of Water Resources

3.0150 MEETING THE EARTHQUAKE CHALLENGE - FINAL REPORT TO THE LEGISLATURE STATE OF CALIFORNIA BY THE JOINT COMMITTEE ON SEISMIC SAFETY

K.V. STEINBRUGGE, State Legislature

3.0151 THE SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971 AND PUBLIC POLICY

UNKNOWN, State Legislature

LOS ANGELES COUNTY GOVERNMENT - CALIFORNIA

3.0004 REPORTS OF THE EARTHQUAKE TASK FORCES - RECOMMENDATIONS OF THE LOS ANGELES COUNTY EARTHQUAKE COMMISSION

UNKNOWN, Los Angeles Co. Bd. of Supvs.

NATL. ACADEMY OF SCIENCES - WASHINGTON

3.0054 EARTHQUAKES RELATED TO RESERVOIR FILLING

UNKNOWN, Natl. Res. Council

3.0186 TOWARD REDUCTION OF LOSSES FROM EARTHQUAKES

UNKNOWN, Natl. Acad. of Sciences

NATL. CONCRETE & MASONRY ASSN. - ARLINGTON

3.0193 EARTHQUAKE DESIGN FOR MASONRY STRUCTURES

F.Y. YOKEL, U.S. Dept. of Commerce, Natl. Bureau of Standards

NO FORMAL SUPPORT REPORTED

3.0048 COMPARISONS OF SEISMIC ANALYSES OF TWO IDENTICAL STRUCTURES BASED ON SEISMOGRAMS FROM THE SAN FERNANDO EARTHQUAKE (ABBREV)

S.A. FREEMAN, John A. Blume & Associates

3.0101 RECOMMENDATIONS DEVELOPED FROM REPORTS OF THE EARTHQUAKE COMMISSION AND EARTHQUAKE TASK FORCES - SAN FERNANDO EARTHQUAKE (ABBREV)

UNKNOWN, Los Angeles Co. Bd. of Supvs.

3.0244 PREDICTED SAN FERNANDO EARTHQUAKE SPECTRA - GLENDALE AREA

J.R. MURPHY, Environmental Res. Corporation

3.0256 COMPILATION OF BRITTLE STRUCTURES WITHIN NEW YORK STATE

Y.W. ISACHSEN, State Dept. of Education

3.0270 REGIONAL EARTHQUAKE RISK STUDY - MISSOURI, ARKANSAS, KENTUCKY, TENNESSEE, MISSISSIPPI AREA

UNKNOWN, Mississippi Ark. Tenn. Council

U.S. ATOMIC ENERGY COMMISSION

3.0013 INVESTIGATION OF GROUND MOTION-DAMAGE RELATIONSHIPS FOR RESIDENTIAL BUILDINGS IN GLENDALE, CALIFORNIA-SAN FERNANDO EARTHQUAKE, FEBRUARY 1

J. FARHOOMAND, John A. Blume & Associates

3.0014 RESPONSE OF TWO IDENTICAL SEVEN-STORY STRUCTURES TO THE SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971

S.A. FREEMAN, John A. Blume & Associates

3.0015 OBSERVATIONS OF DAMAGE TO GLENDALE SWIMMING POOLS, MOBILE HOMES, AND COMMERCIAL BUILDINGS RESULTING FROM SAN FERNANDO EARTHQUAKE OF 1971

W.H. NELSON, John A. Blume & Associates

3.0017 DAMAGE SURVEY, SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971

UNKNOWN, John A. Blume & Associates

3.0018 STRUCTURAL EFFECTS OF THE FAIRBANKS, ALASKA EARTHQUAKE OF JUNE 21, 1967

UNKNOWN, John A. Blume & Associates

3.0056 HYDRAULIC, GEOLOGIC & SEISMOLOGIC STUDIES

G. DEBUCHANNE, U.S. Dept. of the Interior, Geological Survey

3.0072 INSTALLATION AND OPERATION OF A TELEMETERED SEISMIC NETWORK ON THE ALASKA PENINSULA

UNKNOWN, Univ. of Alaska, Geophysical Institute

3.0154 ELEMENTS OF DYNAMIC-INELASTIC DESIGN CODE

J.A. BLUME, John A. Blume & Associates

3.0220 ALEUTIAN SEISMICITY - MILROW SEISMIC EFFECTS

E.R. ENGDAL, U.S. Dept. of Commerce, Natl. Ocean Survey

3.0222 IMPROVED BODY-WAVE MAGNITUDES OF ALEUTIAN EARTHQUAKES

A.C. YARR, U.S. Dept. of Commerce, Natl. Ocean Survey

- R. MILLER, Stone & Webster Engin. Corp.
- 3.0245 SEISMICITY OF THE SOUTHERN NEVADA REGION, DECEMBER 22, 1971 TO JULY 1, 1972
K.C. BAYER, U.S. Dept. of Commerce, Earth Sciences Laboratory
- 3.0246 EARTHQUAKES RECORDED BY A SEISMOGRAPH NETWORK LOCATED IN THE SOUTHERN NEVADA REGION, JANUARY 1-DECEMBER 22, 1971
K.C. BAYER, U.S. Dept. of Commerce, Earth Sciences Laboratory
- 3.0247 ALEUTIAN SEISMIC PROGRAM HYPOCENTER SUMMARY, OCTOBER 1972-APRIL 1973
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 3.0262 A COMPREHENSIVE STUDY OF THE SEISMOTECTONICS OF THE ALEUTIAN ARC - ALASKA
L.R. SYKES, Columbia University, Lamont Doherty Geol. Observ.
- 3.0265 SURVEY REPORT ON STRUCTURAL DESIGN OF PIPING SYSTEMS AND COMPONENTS
E.C. RODABAUGH, Battelle Memorial Institute
- 3.0271 DYNOR - DYNAMIC ANALYSIS OF STRUCTURAL SYSTEMS
R.M. HOLMES, Oak Ridge National Laboratory
- 3.0272 EARTHQUAKES INDUCED BY UNDERGROUND FLUID INJECTION
W.C. MCCLAIN, Oak Ridge National Laboratory
- 3.0278 SOIL BEHAVIOR UNDER EARTHQUAKE LOADING CONDITIONS
UNKNOWN, Shannon & Wilson Incorporated

U.S. DEPT. OF COMMERCE - N.B.S.

- 3.0055 ENGINEERING ASPECTS OF THE 1971 SAN FERNANDO EARTHQUAKE
H.S. LEW, U.S. Dept. of Commerce, Building Research Div.
- 3.0188 BUILDING PRACTICES FOR DISASTER MITIGATION
C.G. CULVER, U.S. Dept. of Commerce, Natl. Bureau of Standards
- 3.0190 INELASTIC RESPONSE OF BUILDINGS AND STRUCTURAL RESTORATION
S.G. FATTAL, U.S. Dept. of Commerce, Natl. Bureau of Standards
- 3.0191 DESIGN, SITING, AND CONSTRUCTION OF LOW-COST HOUSING AND COMMUNITY BUILDINGS TO BETTER WITHSTAND EARTHQUAKES AND WINDSTORMS
W.F. REPS, U.S. Dept. of Commerce, Center For Building Technology
- 3.0194 DESIGN CRITERIA FOR MASONRY
F.Y. YOKEL, U.S. Dept. of Commerce, Natl. Bureau of Standards
- 3.0195 FULL SCALE TEST ON A TWO-STORY HOUSE SUBJECTED TO LATERAL LOAD

- 3.0002 STUDIES IN SEISMICITY AND EARTH DAMAGE STATISTICS, APPENDIX B
K.V. STEINBRUGGE, U.S. Dept. of Commerce, Ocean Survey
- 3.0019 ENGINEERING SEISMOLOGY
L.R. ALDREDGE, U.S. Dept. of Commerce, Research Laboratories
- 3.0024 STUDIES IN SEISMICITY AND EARTH DAMAGE STATISTICS, APPENDIX B
S.T. ALGERMISSEN, U.S. Dept. of Commerce, Research Laboratories
- 3.0025 THE SANTA ROSA, CALIFORNIA EARTHQUAKES OF OCTOBER 1, 1969
K.V. STEINBRUGGE, U.S. Dept. of Commerce, Ocean Survey
- 3.0049 TSUNAMI RESEARCH
S.T. ALGERMISSEN, U.S. Dept. of Commerce, Research Laboratories
- 3.0155 MEASUREMENT OF MOVEMENT ON THE ANDREAS FAULT
R.D. NASON, U.S. Dept. of Commerce, Research Laboratories
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3.0147 A STUDY OF STRONG EARTHQUAKE GROUND MOTION USING AN ARRAY OF ACCELEROGRAPHS - CALIFORNIA

M.D. TRIFUNAC, Calif. Inst. of Technology, School of Engineering

3.0148 ANALYSIS OF THE EARTHQUAKE RESPONSE OF A NINE-STORY STEEL FRAME BUILDING DURING THE SAN FERNANDO EARTHQUAKE

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3.0153 EARTH STRUCTURE AND FAULT TECTONICS AS RELATED TO EARTHQUAKE PREDICTION - CALIFORNIA

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3.0192 BUILDING PRACTICES FOR DISASTER MITIGATION

R.N. WRIGHT, U.S. Dept. of Commerce, Natl. Bureau of Standards

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3.0205 STRESS-STRAIN RELATIONSHIPS OF REINFORCING BARS SUBJECTED TO LARGE STRAIN REVERSALS

A.E. AKTAN, Univ. of Illinois, School of Engineering

3.0206 EFFECTS OF TWO-DIMENSIONAL EARTHQUAKE MOTION ON A REINFORCED CONCRETE COLUMN

A.E. AKTAN, Univ. of Illinois, School of Engineering

3.0208 PROBABILISTIC METHODS IN CIVIL ENGINEERING

A.H. ANG, Univ. of Illinois, School of Engineering

3.0210 RESPONSE AND ENERGY-DISSIPATION OF REINFORCED CONCRETE FRAMES SUBJECTED TO STRONG BASE MOTIONS

P. GULKAN, Univ. of Illinois, School of Engineering

3.0211 EARTHQUAKE EFFECTS ON REINFORCED CONCRETE BUILDINGS

M.A. SOZEN, Univ. of Illinois, School of Engineering

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3.0214 SHEAR STRENGTH DECAY IN REINFORCED CONCRETE COLUMNS SUBJECTED TO LARGE DEFLECTION REVERSALS

J.K. WIGHT, Univ. of Illinois, School of Engineering

3.0215 PROBABILISTIC ANALYSIS OF ELASTO-PLASTIC STRUCTURES

T.L. PAEZ, Purdue University, School of Civil Engin.

3.0216 SHEAR MODULUS AND DAMPING IN SOILS - DESIGN EQUATIONS AND CURVES

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3.0226 SEISMIC GROUND EFFECTS IN THE LIGHT OF NEW THEORIES OF TECTONICS AND EARTHQUAKE

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3.0228 NONLINEAR AND COUPLED SEISMIC RESPONSE OF EARTHQUAKES

J.M. ROESSET, Mass. Inst. of Technology, Engineering

3.0229 SEISMIC DESIGN DECISION AND ANALYSIS OF EARTHQUAKE IN EASTERN METROPOLITAN AREAS

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R.V. WHITMAN, Mass. Inst. of Technology, Engineering

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V.L. STREETER, Univ. of Michigan, School of Engineering

3.0236 A MICROEARTHQUAKE STUDY OF THE MISSISSIPPI VALLEY - ARKANSAS, MISSOURI, TENNESSEE

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W. STAUDER, St. Louis University, School of Engineering

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J. YANG, Univ. of New Mexico, Bureau of Research

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P.H. WIRSCHING, Univ. of New Mexico, School of Engineering Research

3.0253 ADAPTIVE STRUCTURAL SYSTEMS FOR EARTHQUAKE ENGINEERING

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C.H. SCHOLZ, Columbia University, School of Earth and Planetary Sciences, Geolog. Observ.

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L.R. SYKES, Columbia University, Lamont Geological Observatory

3.0264 AGE, GEOMETRY, AND STRESS OF FOUR MAJOR FAULTS OF THE TRANSVERSE RANGES BY EVALUATING

3.0268 SEISMIC HAZARD REGIONALIZATION AND PROBABILITY OF FUTURE EARTHQUAKES IN THE UNITED STATES

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K.H. STOKOE, Univ. of Texas, Graduate School

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S.H. WARD, Univ. of Utah, School of Mines

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R.C. BOSTROM, Univ. of Washington, School of Arts

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R.S. CROSSON, Univ. of Washington, School of Arts

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B. GONEN, Univ. of Washington, School of Engineering

3.0282 SEISMIC RESISTANCE OF CONCRETE SLAB TO COLUMN AND WALL CONNECTIONS

N.M. HAWKINS, Univ. of Washington, School of Engineering

3.0283 SEISMIC ACTIVITY OF THE CASCADE VOLCANOES

S.W. SMITH, Univ. of Washington, School of Arts

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3.0189 STRENGTH OF EXISTING MASONRY WALLS

S.G. FATTAL, U.S. Dept. of Commerce, Natl. Bureau of Standards

3.0201 EARTHQUAKE RESISTANT DESIGN REQUIREMENTS FOR VA HOSPITAL FACILITIES

UNKNOWN, U.S. Veterans Administration, Hospitals Clinics & Reg. Off.

UNIVERSITY OF CALIFORNIA

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T. IWASAKI, Univ. of California, Earthquake Engin. Res. Ctr.

3.0029 EARTHQUAKE RESPONSE OF GRAVITY DAMS INCLUDING RESERVOIR INTERACTION

P. CHAKRABARTI, Univ. of California, Earthquake Engin. Res. Ctr.

3.0033 STOCHASTIC INELASTIC RESPONSE OFFSHORE TOWERS TO STRONG EARTHQUAKES

M.K. KAUL, Univ. of California, Earthquake Ctr.

3.0035 SHAKE - A COMPUTER PROGRAM FOR EARTHQUAKE RESPONSE ANALYSIS OF TALLY LAYERED SITES

P.B. SCHNABEL, Univ. of California, Earthquake Res. Ctr.

3.0073 STIFFNESS DEGRADATION OF REINFORCED CONCRETE MEMBERS SUBJECTED TO FLEXURAL MOMENTS

E.V. BERTERO, Univ. of California, Earthquake Ctr.

3.0076 EXPERIMENTAL INVESTIGATION OF THE SEISMIC BEHAVIOR OF CRITICAL REINFORCED CONCRETE COMPONENTS INFLUENCED BY MOMENT AND SHEAR

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3.0077 ADAP - A COMPUTER PROGRAM FOR STATIC AND DYNAMIC ANALYSIS OF ARCH DAMS

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J.M. KELLY, Univ. of California, Earthquake Ctr.

3.0082 INELASTIC BEHAVIOR OF STEEL COLUMN SUBASSEMBLAGES

H. KRAVINKLER, Univ. of California, Earthquake Res. Ctr.

3.0083 INFLUENCE OF BASE ROCK CHARACTERISTICS ON GROUND RESPONSE

J. LYSMER, Univ. of California, Earthquake Ctr.

3.0084 RATE OF LOADING EFFECTS ON UNREINFORCED AND REPAIRED REINFORCED CONCRETE MEMBERS

S.A. MAHIN, Univ. of California, Earthquake Ctr.

3.0085 ELASTIC-PLASTIC EARTHQUAKE RESPONSE OF SOIL-BUILDING SYSTEMS

T. MINAMI, Univ. of California, Earthquake Ctr.

3.0088 CYCLIC BEHAVIOR OF THREE REINFORCED CONCRETE (R.C.) FLEXURAL MEMBERS UNDER HIGH SHEAR

E.P. POPOV, Univ. of California, Earthquake Ctr.

3.0089 CYCLIC LOADING OF FULL-SCALE REINFORCED CONCRETE WALLS

E.P. POPOV, Univ. of California, Earthquake Ctr.

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P.B. SCHNABEL, Univ. of California, Earthquake Engin.
Res. Ctr.

3.0093 MODIFICATION OF SEISMOGRAPH RECORDS FOR EFFECTS OF LOCAL SOIL CONDITIONS

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Res. Ctr.

3.0095 ANALYSIS OF THE SLIDES IN THE SAN FER- NANDO DAMS DURING THE EARTHQUAKE OF FEBRUARY 9, 1971

H.B. SEED, Univ. of California, Earthquake Engin. Res.
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3.0096 SOIL MODULI AND DAMPING FACTORS FOR DYNAMIC RESPONSE ANALYSES

H.B. SEED, Univ. of California, Earthquake Engin. Res.
Ctr.

3.0097 A SIMPLIFIED PROCEDURE FOR EVALUATING SOIL LIQUEFACTION POTENTIAL

H.B. SEED, Univ. of California, Earthquake Engin. Res.
Ctr.

3.0098 ANALYTICAL INVESTIGATIONS OF THE SEISMIC RESPONSE OF LONG MULTIPLE SPAN HIGHWAY BRIDGES

W. TSENG, Univ. of California, Earthquake Engin. Res. Ctr.

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E.L. WILSON, Univ. of California, Earthquake Engin. Res.
Ctr.

UNIVERSITY OF ILLINOIS

3.0059 SEISMIC DESIGN OF LOW-RISE BUILDINGS

W.J. HALL, Univ. of Illinois, School of Engineering

3.0207 SEISMIC BEHAVIOR OF FRAMED TUBES

J.C. ANDERSON, Univ. of Illinois, Graduate School

3.0209 ANALYSIS OF LIQUEFACTION OF SATURATED GRANULAR SOILS DURING EARTHQUAKES

J. GHABOUSSI, Univ. of Illinois, School of Engineering

3.0213 PROBABILISTIC MODELING OF EXTREME LOADS

Y.K. WEN, Univ. of Illinois, School of Engineering

EXPANSIVE SOILS

U.S. DEPT. OF DEFENSE - ARMY

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L.D. JOHNSON, U.S. Army, Waterways Experiment Station

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L.D. JOHNSON, U.S. Army, Waterways Experiment Station

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J.T. ALFORD, State Div. of Mines & Geology

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R.D. RICHMOND, U.S. Dept. of the Interior
Reclamation

U.S. DEPT. OF INTERIOR - GEOLOGICAL

4.0004 GEOLOGY OF THE RAPID CITY AR DAKOTA

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4.0005 DENVER URBAN CORRIDOR S COLORADO

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4.0006 SURFICIAL GEOLOGY OF JUNEAU A TY URBAN AREA, ALASKA

R.D. MILLER, U.S. Dept. of the Interior, Geol.

U.S. NATL. SCIENCE FOUNDATION

4.0008 UNIVERSITY-INDUSTRY WORKS HAZARDS AND DAMAGE RELATED TO EARTH MATERIALS

D. RICHARD, Univ. of Denver, Graduate School

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4.0009 MAPPING OF SURFACE MATERIAL DICTING FOUNDATION CHARACTERIS TURE DEVELOPMENT OF HATTIESBURG

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J.E. DUNKELBERGER, Auburn University, Ag
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L.R. GREEN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta.
- 5.0010 A STUDY OF FOREST SERVICE TELECOMMUNICATIONS - VOLUME I - SUMMARY - MAIN STUDY RECOMMENDATIONS AND FINDINGS
UNKNOWN, U.S. Dept. of Agriculture, Div. of Administrative Mgmt.
- 5.0015 FOREST FIRES IN MISSOURI
D.A. HAINES, U.S. Dept. of Agriculture, North Cen. Forest Expt. Sta.
- 5.0016 FIRE WEATHER & BEHAVIOR OF THE LITTLE SIOUX FIRE - MINNESOTA
R.W. SANDO, U.S. Dept. of Agriculture, North Cen. Forest Expt. Sta.
- 5.0028 AIRBORNE INFRARED FOREST FIRE DETECTION SYSTEM
R.A. WILSON, U.S. Dept. of Agriculture, Northern Forest Fire Lab.
- 5.0033 FIRE ENVIRONMENTAL TEST CHAMBER - ITS DESIGN AND DEVELOPMENT
C.J. AUVIL, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta.
- 5.0034 FIRES CAUSED BY EQUIPMENT USED DURING CRITICAL FIRE WEATHER IN CALIFORNIA, 1962 - 1971
G.C. BERNARDI, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta.
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F.W. BRATTEN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta.
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- 5.0037 REDUCING FIRE HAZARD IN PONDEROSA PINE THINNING SLASH BY MECHANICAL CRUSHING - OREGON
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R.M. MEES, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta.
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D.A. HAINES, U.S. Dept. of Agriculture, North Cen. Forest Expt. Sta.

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- 5.0002 PRESCRIBED FIRE TECHNOLOGY FOR THE SOUTHWEST
A.W. LINDENMUTH, Northern Ariz. University, U.S.D.A. Rky. Mtn. Forest Sta.
- 5.0006 FOREST FIRE BEHAVIOR - CALIFORNIA
C.M. COUNTRYMAN, U.S. Dept. of Agriculture, Pac. SW For. & Rg. Expt. Sta.
- 5.0007 FIRE MANAGEMENT SYSTEMS
J.B. DAVIS, U.S. Dept. of Agriculture, Pac. SW For. & Rg. Expt. Sta.
- 5.0011 DEVELOPMENT OF NEW AND IMPROVED FIRE CONTROL METHODS FOR SOUTHERN FORESTS
R.W. JOHANSEN, U.S. Dept. of Agriculture, S.E. Forest Experiment Station
- 5.0014 FIRE CONTROL PLANNING AND FIRE PREVENTION IN THE NORTHEASTERN UNITED STATES
V.J. JOHNSON, Michigan State University, U.S.D.A. N. Cen. For. Ex. Sta.
- 5.0017 RESEARCH AND DEVELOPMENT OF FIRE PREVENTION TECHNOLOGY (FIRE PREVENTION)
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H.E. ANDERSON, U.S. Dept. of Agriculture, Intermtn. For. & Rg. Expt. Sta.
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R.G. BAUGHMAN, U.S. Dept. of Agriculture, Intermtn. For. & Rg. Expt. Sta.
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C.E. HARDY, U.S. Dept. of Agriculture, Intermtn. For. & Rg. Expt. Sta.
- 5.0025 FIRE PREVENTION - CALIFORNIA
W.S. FOLKMAN, U.S. Dept. of Agriculture, Pac. Sw. For. & Rg. Expt. Sta.
- 5.0027 NATIONAL FIRE DANGER RATING
J.W. LANCASTER, Colorado State University, U.S.D.A. Rocky Mtn. For. Sta.
- 5.0040 FOREST FIRE METEOROLOGY IN THE PACIFIC COASTAL REGION
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- 5.0042 DEVELOPMENT OF IMPROVED TECHNIQUES FOR USING PRESCRIBED FIRE IN SOUTHERN FORESTS
R.W. COOPER, U.S. Dept. of Agriculture, S.E. Forest Experiment Station
- 5.0043 THE INFLUENCE OF WEATHER AND CLIMATE ON FOREST FIRE OCCURRENCE AND BEHAVIOR IN THE EAST AND SOUTH

S.N. HIRSCH, U.S. Dept. of Agriculture, Intermt. For. & Rg. Exp. Sta.

U.S. DEPT. OF COMMERCE - N.O.A.A.

5.0029 RADAR METEOROLOGY AS A MODERN TOOL FOR FOREST FIRE PROTECTION
D.W. KRUEGER, U.S. Dept. of Commerce, Natl. Weather Service

5.0031 OPERATING PLAN FOR FIRE WEATHER SERVICE IN SOUTH CAROLINA
J.D. KANUPP, U.S. Dept. of Commerce, Natl. Weather Service

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V.I. BINENKO, U.S. Air Force, Foreign Technology Division

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5.0023 NATURAL DISASTERS OPERATIONS PLANNING FOR SLOWLY DEVELOPING DISASTERS, VOLUME I
A. SACHS, Inst. For Defense Analysis

U.S. DEPT. OF DEFENSE - NAVY

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R.S. ALGER, U.S. Navy, Ordnance Laboratory

U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

5.0026 URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)
J.T. ALFORE, State Div. of Mines & Geology

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H.A. WRIGHT, Texas Technological University, School of Agriculture
5.0044 DEVELOPMENT OF EMISSION FACTORS FOR ESTIMATING ATMOSPHERIC EMISSIONS
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R.H. WHITTAKER, Cornell University, School of Biological Sciences

5.0024 MECHANISMS OF WILDLAND FIRE SUPPRESSION
R.C. CORLETT, Univ. of Washington, School of Engineering

5.0041 FOREST FIRE STATISTICAL PROBLEMS
F.M. DAVID, Univ. of California, School of Agriculture

FLOODS

ALABAMA STATE GOVERNMENT - MONTGOMERY

6.0214 FLOOD FREQUENCY SYNTHESIS FOR SMALL STREAMS - ALABAMA
C.O. MING, U.S. Dept. of the Interior, Geological Survey

AUBURN UNIVERSITY

6.0157 STUDY OF GUIDELINES FOR LAND MANAGEMENT AND USE OF FLOOD-PRONE AREAS IN ALABAMA
S.P. SNOOK, Auburn University, Center For Urban & Reg. Plan.

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6.0044 SOUTH COASTAL BASIN PRECIPITATION FREQUENCY - A REGIONAL ANALYSIS OF DEPLETION FREQUENCY OF SHORT-DURATION PRECIPITATION IN CALIFORNIA
J.D. GOODRIDGE, State Dept. of Water Resources

CHICAGO CITY GOVERNMENT - ILLINOIS

6.0083 DEVELOPMENT OF A FLOOD AND POLLUTION CONTROL PLAN FOR THE CHICAGOLAND AREA - COMPUTER SIMULATION PROGRAMS
D.H. CHURCHILL, Illinois Inst. For Envir. Qlty

COLORADO STATE UNIVERSITY - FORT COLLINS

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V. YEVJEVICH, Colorado State University, School of Engineering

FLORIDA STATE GOVERNMENT - TALLAHASSEE

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- 6.0084 BACKGROUND SURVEY - SURFACE DRAINAGE PROGRAM. MADISON, ST. CLAIR, MONROE AND RANDOLPH COUNTIES, ILLINOIS
UNKNOWN, Southwestern Ill. Plan. Comm.
- 6.0263 STREAMFLOW VARIABILITY - ILLINOIS
K.P. SINGH, State Water Survey

IOWA STATE GOVERNMENT - DES MOINES

- 6.0064 COLLECTION AND ANALYSIS OF STREAM FLOW AND RELATED HYDRAULIC DATA FOR DESIGN OF HIGHWAY BRIDGES AND CULVERTS - IOWA
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

MISSISSIPPI RES. & DEV. CENTER - JACKSON

- 6.0309 ZONING ORDINANCE AND SUBDIVISION REGULATIONS, FRIARS POINT, MISSISSIPPI
P.J. BARLOW, State Comm. & Area Dev. Div

MONTANA STATE UNIVERSITY - BOZEMAN

- 6.0125 APPLICATION OF HYDROLOGIC AND HYDRAULIC RESEARCH TO CULVERT SELECTION IN MONTANA - VOLUME I - REPORT
E.R. DODGE, Montana State University, School of Engineering

NEW JERSEY STATE GOVERNMENT - TRENTON

- 6.0323 HYDROLOGY OF SUBURBAN AREAS - NEW JERSEY
K. NATHAN, Rutgers the State University, Agricultural Experiment Sta.

NEW YORK STATE GOVERNMENT - ALBANY

- 6.0130 REGIONAL COMPREHENSIVE MULTI-PURPOSE WATER RESOURCES PLANNING STUDIES IN NEW YORK
J.A. FINCK, State Dept. of Env. Conserv.
- 6.0337 APPLICATION OF LUNR SYSTEM TO FLOOD PLAIN ANALYSIS AND MANAGEMENT IN THE SUSQUEHANNA RIVER BASIN
J.W. KELLEY, State University of New York, Agricultural Experiment Sta.

NO FORMAL SUPPORT REPORTED

- 6.0016 A STATISTICAL SUMMARY OF THE CAUSE AND COST OF BRIDGE FAILURES
F.F. CHANG, Fed. City College, Graduate School
- 6.0035 ELEMENTS OF THE WATER RESOURCES SITUATION IN ALABAMA
D.B. KNOWLES, State Geol. Survey
- 6.0052 REGULATION OF GREAT LAKES WATER

6.0170 GLENDORA, CALIFORNIA, GENERAL 1990

UNKNOWN, Glendora City Government

- 6.0177 PROCEDURES FOR ESTIMATING FLOOD FROM SMALL RURAL WATERSHEDS
R.K. LINSLEY, Hydrocomp International

- 6.0229 FLOOD HAZARD EVALUATION GUIDE FOR FEDERAL EXECUTIVE AGENCIES
UNKNOWN, U.S. Water Resources Council

- 6.0299 PREDICTION OF THE MAGNITUDE FREQUENCIES OF FLOODS IN MICHIGAN
E.F. BRATER, Univ. of Michigan, School of Engineering

OHIO STATE GOVERNMENT - COLUMBUS

- 6.0347 DETERMINATION OF COST-EFFECTIVE TECHNICAL PROCEDURES FOR USE IN THE FLOOD PLAIN MANAGEMENT PROGRAM
G.M. CLARK, Ohio State University, School of Engineering
- 6.0348 STREAMFLOW SIMULATION AND PROFILE DETERMINATION IN OHIO - STUDY
V.T. RICCA, Ohio State University, School of Engineering

OHIO STATE UNIVERSITY

- 6.0346 APPLICATION OF COST-EFFECTIVE THE DESIGN OF A FLOOD PLAIN
G.M. CLARK, Ohio State University, School of Engineering

PALM BEACH COUNTY GOVERNMENT - FORT PALM

- 6.0235 FLOOD PLAIN STUDY AND MODELING PLAIN ORDINANCE
UNKNOWN, Palm Beach Co. Area Plan. Bd.

RIVERSIDE COUNTY GOVT. - CALIF.

- 6.0042 SAN GORGONIO PASS, CALIFORNIA FLOOD PLAN TECHNICAL REPORT
UNKNOWN, Council on Intergov. Relations

SALT LAKE COUNTY GOVERNMENT - UTAH

- 6.0031 STUDIES IN CONNECTION WITH HYDROLOGIC AND RELATED PHYSICAL PROCESSES IN THE OLYMPUS COVE AREA OF SALT LAKE COUNTY
J.P. RILEY, Utah State University, Utah Ctr. Resour. Res.

TEXAS STATE GOVERNMENT - AUSTIN

- 6.0388 RELATION OF CLIMATIC AND WATER CHARACTERISTICS TO STORM RUNOFF IN THE GUADALUPE PLATEAU - TEXAS
W.G. KNISEL, U.S. Dept. of Agriculture, Blackland Watershed

U.S. DEPT. OF AGRICULTURE

- UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0195 KANSAS - NORTH SECTOR UPPER WALNUT WATERSHED BUTLER AND CHASE COUNTIES
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0196 UNION CREEK WATERSHED PROJECT, SOUTH DAKOTA
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0197 HOLLOW CREEK WATERSHED PROJECT, SOUTH CAROLINA
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0198 KANSAS - NORTH SECTOR UPPER WALNUT WATERSHED BUTLER AND CHASE COUNTIES
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0199 NUTWOOD WATERSHED, ILLINOIS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0200 HURRICANE CREEK WATERSHED STRUCTURAL PROJECT MEASURE, KENTUCKY
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0201 CORNUDAS, NORTH AND CULP DRAWS WATERSHED, HUDSPETH COUNTY, TEXAS, AND OTERO COUNTY, NEW MEXICO
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0202 BIG CREEK WATERSHED, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0203 MACADOO ROAD-FILL DAM, KANSAS
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0204 STARKWEATHER WATERSHED, NORTH DAKOTA
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0205 VERDE LANE FLOOD PREVENTION PROJECT MEASURE, NEBRASKA
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service
- 6.0206 WHITEWATER CREEK HYDROLOGIC UNIT PROJECT MEASURE, CHEROKEE HILLS RC AND D PROJECT, OKLAHOMA
UNKNOWN, U.S. Dept. of Agriculture, Soil Conservation Service

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- 6.0085 LABORATORY STUDIES OF CONSERVATION AND DRAINAGE STRUCTURES
B.A. JONES, Univ. of Illinois, Agricultural Experiment Sta.
- 6.0265 RUNOFF FROM SMALL AGRICULTURAL AREAS IN ILLINOIS

D.J. ALLEE, State University of New York, Agricultural Experiment Sta.

U.S. DEPT. OF AGRICULTURE - E.R.

- 6.0194 ANALYSIS OF LAND USE CONTROL
W.D. ANDERSON, U.S. Dept. of Agriculture, Resource Econ. Div.

U.S. DEPT. OF AGRICULTURE - F.

- 6.0041 FLOOD AND SEDIMENT REDUCTION UNSTABLE BRUSHLANDS OF THE SOUTH
R.M. RICE, U.S. Dept. of Agriculture, Pacific Reg. Exp. Sta.

U.S. DEPT. OF COMMERCE - E.S.S.

- 6.0057 ESSA AND OPERATION FORESIGHT
UNKNOWN, U.S. Dept. of Commerce, National Atmos. Admin.

U.S. DEPT. OF COMMERCE - N.B.

- 6.0001 DISASTER INVESTIGATIONS
C.G. CULVER, U.S. Dept. of Commerce, National Standards

U.S. DEPT. OF COMMERCE - N.O.A.

- 6.0006 FLOOD INSURANCE STUDY
D. FEIT, U.S. Dept. of Commerce, Technical Lab.
- 6.0021 METEOROLOGICAL AND HYDROLOGICAL ANALYSIS OF THE AUGUST 27-28, 1971 SEY FLOOD
H.S. GROPER, U.S. Dept. of Commerce, Weather Service
- 6.0022 THE METEOROLOGICAL AND HYDROLOGICAL ASPECTS OF THE MAY 1968 NEW JERSEY FLOOD
A.S. KACHIC, U.S. Dept. of Commerce, Weather Service
- 6.0036 WORTH OF HYDROLOGIC DATA IN SHORT-TERM FORECASTS OF FLOODS
M. SNIEDOVICH, Univ. of Arizona, Graduate School
- 6.0056 BLACK HILLS FLOOD OF JUNE 9, 1936
UNKNOWN, U.S. Dept. of Commerce, National Atmos. Admin.

- 6.0070 STUDIES OF THE RED ALGAE IN THE BAY
A. THORHAUG, Univ. of Miami, School of Marine Biology

- 6.0081 WATER WARNINGS AND SHORT-TERM FORECASTS
UNKNOWN, U.S. Air Force, Air Weather Service

- 6.0103 HYDROLOGIC DATA COLLECTION AND STATIONARY SATELLITE
A.F. FLANDERS, U.S. Dept. of Commerce, Weather Service

- 6.0104 HYDROLOGIC EQUIPMENT - FLOOD ALARM SYSTEM

C. HETRICK, Univ. of California, School of Letters

6.0207 LAKE HYDROLOGY

L. BAJORUNAS, U.S. Dept. of Commerce, Limnology Division

6.0289 CLIMATES OF THE STATES - CLIMATE OF NEW YORK

A.B. PACK, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

6.0290 PROBABLE MAXIMUM PRECIPITATION AND SNOWMELT CRITERIA FOR RED RIVER OF THE NORTH ABOVE PEMOINA AND SOURIS RIVER ABOVE MINOT, NORTH DAKOTA

J.T. RIEDEL, U.S. Dept. of Commerce, National Weather Service

6.0341 EROSION AND DEPOSITION IN THE SOUNDS AND ESTUARIES OF THE NORTH CAROLINA COAST

R.L. INGRAM, Univ. of North Carolina, School of Arts

6.0359 ALTERNATIVE ADJUSTMENTS TO NATURAL HAZARDS

D.G. AREY, Univ. of Pittsburgh, Graduate School

6.0391 FLASH FLOOD FORECASTING AND WARNING PROGRAM IN THE WESTERN REGION

P. WILLIAMS, U.S. Dept. of Commerce, Natl. Weather Service

U.S. DEPT. OF DEFENSE - ARMY

6.0017 UPPER MISSISSIPPI RIVER COMPREHENSIVE BASIN STUDY - VOLUME V, APPENDIX I - FLOOD CONTROL

UNKNOWN, Upper Miss. Riv. Comp. Comm.

6.0032 NATURAL DISASTERS OPERATIONS PLANNING FOR SLOWLY DEVELOPING DISASTERS, VOLUME I

A. SACHS, Inst. For Defense Analysis

6.0033 SPEWRELI, BLUFF LAKE, FLINT RIVER, GEORGIA

UNKNOWN, U.S. Army, Engineer District

6.0037 HYDROLOGIC ENGINEERING METHODS FOR WATER RESOURCES DEVELOPMENT - VOLUME I - REQUIREMENTS AND GENERAL PROCEDURES

L.R. BEARD, U.S. Army, Hydrologic Engineering Center

6.0038 RESERVOIR SYSTEMS ANALYSIS FOR FLOOD CONTROL

B.S. EICHERT, U.S. Army, Hydrologic Engineering Center

6.0053 CHENA RIVER LAKES PROJECT, ALASKA - PROBLEMS RELATING TO CHANNEL DEVELOPMENT, EROSION, & BANK & LEVEE PROTECTION

C.P. LINDNER, U.S. Army, Corps of Engineers

6.0054 JACKSON HOLE FLOOD CONTROL PROJECT

UNKNOWN, U.S. Army, Corps of Engineers

6.0086 OAKLEY-SANGAMON REMOTE SENSING ENVIRONMENTAL RESEARCH PROGRAM - ILLINOIS

H.M. KARARA, Univ. of Illinois, School of Engineering

6.0095 HYDROLOGIC STUDIES (STORM STUDIES)

B.L. GARRATT, U.S. Army, Engineering Division

UNKNOWN, U.S. Army, Engineer District

6.0097 NEW ORLEANS TO VENICE, LOUISIANA, HURRICANE PROTECTION

UNKNOWN, U.S. Army, Engineer District

6.0098 LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY - HURRICANE PROTECTION PROJECT

UNKNOWN, U.S. Army, Engineer District

6.0099 MORGAN CITY, LOUISIANA, AND VICINITY (FRANKLIN AND VICINITY AREA)

UNKNOWN, U.S. Army, Engineer District

6.0100 RED RIVER EMERGENCY BANK PROTECTION, LOUISIANA, ARKANSAS, AND TEXAS

UNKNOWN, U.S. Army, Engineer District

6.0101 THE IMPLICATIONS OF THE NET FISCAL BENEFITS CRITERION FOR COST SHARING IN FLOOD CONTROL PROJECTS

R.W. RAUFUS, Mathematica Incorporated

6.0108 HURRICANE PROTECTION PROJECT, STRATFORD, CONNECTICUT

UNKNOWN, U.S. Army, New England Division

6.0109 OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, MASSACHUSETTS

UNKNOWN, U.S. Army, New England Division

6.0110 OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, NEW BEDFORD, MASSACHUSETTS

UNKNOWN, U.S. Army, New England Division

6.0111 NEW LONDON HURRICANE PROTECTION PROJECT, NEW LONDON, CONNECTICUT

UNKNOWN, U.S. Army, New England Division

6.0116 DESIGN FOR FLOOD CONTROL AND WAVE PROTECTION, CHAGRIN RIVER, EAST LAKE, OHIO - HYDRAULIC MODEL INVESTIGATION

C.E. CHATHAM, U.S. Army, Waterways Experiment Station

6.0117 DISCHARGE CHARACTERISTICS OF HURRICANE BARRIER, EAST PASSAGE OF NARRAGANSETT BAY, RHODE ISLAND - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station

6.0118 ANSONIA-DERBY LOCAL PROTECTION PROJECT, NAUGATUCK AND HOUSATONIC RIVERS, CONNECTICUT - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station

6.0119 PROTECTION OF NARRAGANSETT BAY FROM HURRICANE SURGES

H.B. SIMMONS, U.S. Army, Waterways Experiment Station

6.0120 FLOOD-CONTROL PROJECT HOOSIC RIVER, NORTH ADAMS MASSACHUSETTS

UNKNOWN, U.S. Army, Waterways Experiment Station

6.0121 FLOOD CONTROL IN THE LOWER MISSISSIPPI RIVER VALLEY

UNKNOWN, U.S. Army, Lower Miss. Valley Div.

- 6.0172 SANTA ANA RIVER BASIN, FLOOD CONTROL PROJECT, EAST TWIN AND WARM CREEK IMPROVEMENT
UNKNOWN, U.S. Army, Engineer District
- 6.0173 COMPUTER SIMULATION MODEL FOR FLOOD PLAIN DEVELOPMENT - PART II - MODEL DESCRIPTION AND APPLICATIONS
N.V. ARVANITIDIS, INTASA Incorporated
- 6.0174 COMPUTER SIMULATION MODEL FOR FLOOD PLAIN DEVELOPMENT - PART I - LAND USE PLANNING AND BENEFIT EVALUATION
N.V. ARVANITIDIS, INTASA Incorporated
- 6.0247 HYDROLOGIC RELATIONS IN HAWAII
D. JAY, U.S. Army, Pacific Ocean Division
- 6.0257 COMMUNITY GOALS - MANAGEMENT OPPORTUNITIES - AN APPROACH TO FLOOD PLAIN MANAGEMENT
J.R. SHEAFFER, Univ. of Chicago, Center For Urban Studies
- 6.0312 MODEL STUDY OF CANNELTON LOCKS AND DAM, OHIO RIVER, INDIANA AND KENTUCKY
J.J. FRANCO, U.S. Army, Waterways Experiment Station
- 6.0313 MISSISSIPPI BASIN MODEL
UNKNOWN, U.S. Army, Waterways Experiment Station
- 6.0314 DEMONSTRATION OF THE ELECTRIC ANALOG MODEL OF THE KANSAS RIVER AT THE UNIVERSITY OF CALIFORNIA IN BERKELEY
UNKNOWN, U.S. Army, Waterways Experiment Station
- 6.0315 FORT SCOTT LAKE, MARMATON RIVER, KANSAS
UNKNOWN, U.S. Army, Engineer District
- 6.0320 MERAMEC PARK LAKE, UPPER MISSISSIPPI RIVER BASIN, MERAMEC RIVER, MISSOURI
UNKNOWN, U.S. Army, Engineer District
- 6.0358 FLOOD-PROOFING REGULATIONS
UNKNOWN, U.S. Army, Engineer District
- 6.0405 FLOOD HAZARD INFORMATION - BUFFALO CREEK, LOGAN COUNTY, WEST VIRGINIA POST-DISASTER CONDITIONS
UNKNOWN, U.S. Army, Corps of Engineers

U.S. DEPT. OF HLTH. ED. & WEL.

- 6.0014 DELIVERING VOCATIONAL REHABILITATION SERVICES IN A DISASTER AREA
W.R. PHELPS, State Div. of Voc. Rehab.
- 6.0398 FLOOD DAMAGE ABATEMENT - FEDERAL ASSISTANCE TO LOCAL GOVERNMENT
W.R. WALKER, Virginia Polytechnic Institute, Water Resources Research Ctr.

U.S. DEPT OF HLTH. ED. & WEL. - A.D.M.J.A.

- 6.0003 SILVER VALLEY FLOOD - SOCIAL PSYCHOLOGICAL EFFECTS

- FLOOD DISASTER AREAS IN COMMONWEALTH OF PENNSYLVANIA
UNKNOWN, State Dept. of Pub. Welfare
- 6.0009 MENTAL HEALTH SERVICES IN FLOOD DISASTER AREAS IN TWO COUNTIES OF THE COMMONWEALTH OF PENNSYLVANIA
UNKNOWN, Hazleton Nanticoke M.H. C.
- 6.0010 TRAINING AND EVALUATION OF HEALTH SERVICES TO RESIDENTS IN FLOOD DISASTER AREAS IN COMMONWEALTH OF PENNSYLVANIA
UNKNOWN, Eastern Penn. Psych. Institut
- 6.0011 MENTAL HEALTH SERVICES IN FLOOD DISASTER AREAS IN TWO COUNTIES, COMMONWEALTH OF PENNSYLVANIA
UNKNOWN, Luzerne Wyoming Co. M.H. C.
- U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

- 6.0002 THE FEDERAL RESPONSE TO STORM AGNES: A REPORT TO THE HOUSE OF REPRESENTATIVES ON PUBLIC WORKS, SUBSIDIES, AND DISASTER RELIEF
UNKNOWN, U.S. Exec. Office of the President, Emergency Preparedness
- 6.0005 FLOOD INSURANCE STUDY
C. BARRIENTOS, U.S. Dept. of Commerce, Weather Service
- 6.0024 LOCK HAVEN URBAN RECOVERY PROJECT, LOCK HAVEN, PENNSYLVANIA
UNKNOWN, U.S. Dept. of Hou. & Urb. Disaster Rec. Off.
- 6.0025 MODEL CITIES ONE - URBAN RECOVERY PROJECT, READING, PENNSYLVANIA
UNKNOWN, U.S. Dept. of Hou. & Urb. Disaster Rec. Off.
- 6.0026 PENNSYLVANIA URBAN RECOVERY PROJECT, HARRISBURG, PENNSYLVANIA
UNKNOWN, U.S. Dept. of Hou. & Urb. Disaster Rec. Off.
- 6.0027 MILTON SOUTH, MILTON NORTH TOWNSHIP DISASTER, URBAN RECOVERY PROJECT, PENNSYLVANIA
UNKNOWN, U.S. Dept. of Hou. & Urb. Disaster Rec. Office
- 6.0028 DOWNTOWN URBAN RECOVERY PROJECT, WILKES-BARRE, PENNSYLVANIA
UNKNOWN, U.S. Dept. of Hou. & Urb. Disaster Rec. Office
- 6.0029 KINGSTON DISASTER URBAN RECOVERY PROJECT, BOROUGH OF KINGSTON, PENNSYLVANIA, HUD PROJECT
UNKNOWN, U.S. Dept. of Hou. & Urb. Disaster Rec. Off.

- J.T. ALFORE*, State Div. of Mines & Geology
- 6.0046 DRAINAGE AND FLOOD CONTROL BACKGROUND AND POLICY STUDY - SAN DIEGO
G.S. NOLTE, San Diego Co. Comp. Plan. Org.
- 6.0047 INITIAL WATER, SEWERAGE AND FLOOD
UNKNOWN, San Diego Co. Comp. Plan. Org.
- 6.0072 ORANGE, SEMINOLE, OSCEOLA COUNTIES -
WATER MANAGEMENT
UNKNOWN, East Cent. Florida Reg. Coun.
- 6.0087 DRAINAGE AND FLOOD CONTROL PLAN -
MARION COUNTY, INDIANA SEPTEMBER 1970
UNKNOWN, Marion Co. Metrop. Dev. Dept.
- 6.0127 PRELIMINARY STORM DRAINAGE AND FLOOD
CONTROL PLAN - UNION COUNTY, N.J.
E.T. KILLAM, Union County Planning Board
- 6.0128 FACTORS PERTINENT TO WATER QUALITY IN
THE ALBUQUERQUE METROPOLITAN AREA
UNKNOWN, Albuquerque Urban Observatory
- 6.0133 WATER RELATED ENVIRONMENTAL SERVICES
UNKNOWN, Central New York Reg. Pln. Bd.
- 6.0148 COMPREHENSIVE PLAN, CITY OF HAMILTON,
TEXAS
UNKNOWN, State Div. of Comp. Planning
- 6.0158 A GUIDE FOR REDUCING FLOOD DAMAGE IN
THE SOUTH ALABAMA REGION
UNKNOWN, South Alabama Reg. Plan. Comm.
- 6.0159 FLOOD MANAGEMENT STUDY
UNKNOWN, Tuscaloosa Area Coun. of Gov.
- 6.0160 FLOOD MANAGEMENT STUDY - TUSCALOOSA,
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UNKNOWN, Tuscaloosa Area Coun. of Gov.
- 6.0178 NORTH RICHMOND - SAN PABLO BAY AREA
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J.P. KENNY, Council on Intergov. Relations
- 6.0179 GENERAL PLAN REPORT, LAKE RED BLUFF
AREA, CALIFORNIA, 1971
UNKNOWN, Council on Intergov. Relations
- 6.0181 DRAINAGE AND FLOOD CONTROL
BACKGROUND AND POLICY STUDY - SUMMARY
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UNKNOWN, San Diego Reg. Comp. Pl. Org.
- 6.0192 RECOMMENDED REGIONAL PLAN FOR
SEWERAGE, WATER SUPPLY AND STORM
DRAINAGE - CONNECTICUT
UNKNOWN, Valley Regional Planning Agcy.
- 6.0231 SARASOTA - ZONING AND SUBDIVISION CON-
TROLS - REVIEW, ANALYSIS, AND RECOMMENDA-
TIONS CONCERNING CURRENT REGULATIONS
E.R. BARTLEY, Tampa Bay Regional Plan. Comm.
- 6.0236 FLOOD PLAIN STUDY AND MODEL FLOOD
PLAIN ORDINANCE, MARCH, 1972
UNKNOWN, Palm Beach Co. Area Plan. Bd.
- 6.0245 WATER RESOURCES OF MIDDLE GEORGIA

- 6.0258 NATURAL CAPABILITIES - THE
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UNKNOWN, Macon Co. Regional Plan Comm.
- 6.0260 A COMPREHENSIVE PLAN FOR STEPHENSON
COUNTY, ILLINOIS
UNKNOWN, Stephenson Co. Planning Comm.
- 6.0262 PRIORITY AND PLANNING ELEMENTS IN
DEVELOPING ILLINOIS WATER RESOURCES
UNKNOWN, State Dept. of Bus. & Dev.
- 6.0268 ZONING ORDINANCE - KNOX COUNTY, TEN-
NESSEE
UNKNOWN, Clyde E. Williams & Assoc. Inc.
- 6.0283 ZONING ORDINANCE AND ORDER, PIKE
COUNTY, ELKHORN CITY, KENTUCKY
UNKNOWN, State Program Dev. Office
- 6.0284 ZONING ORDINANCE - PAINTSVILLE, KEN-
TUCKY
UNKNOWN, State Program Dev. Office
- 6.0286 FLOOD PLAN FOR BULLITT COUNTY, KEN-
TUCKY
A. WAHBY, Bullitt Co. Planning Comm.
- 6.0295 RE-DRAFT OF SEEKONK ZONING BY-
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J. BLACKWELL, State Dept. of Community Affs.
- 6.0307 URBAN SYSTEMS - STORM DRAINAGE, FLOOD
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MENT (BREV)
J.A. ELLIOTT, Diversified Consultants Inc.
- 6.0308 URBAN SYSTEMS - WATERWORKS, SEWERAGE,
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J.A. ELLIOTT, Diversified Consultants Inc.
- 6.0329 STREAMS AND DRAINAGE BASINS - CATTARAUGUS
COUNTY, NEW YORK
UNKNOWN, State Off. of Plan. Services
- 6.0330 PUTNAM COUNTY OFFICIAL PROPOSALS FOR
REVISION AND EXPANSION OF ZONING ORDINANCE
UNKNOWN, State Off. of Plan. Services
- 6.0332 COMPREHENSIVE PLAN - REPORT ON THE
DEVELOPMENT - VILLAGE OF EAST AURORA, N.Y.
UNKNOWN, Aurora Planning Board
- 6.0333 NATURAL CHARACTERISTICS OF CATTARAUGUS
COUNTY, NEW YORK STATE
H.H. LADAGE, Columbia Co. Planning Dept.
- 6.0340 DRAINAGE STUDY - INVENTORY AND ANALYSIS
UNKNOWN, Genesee Finger Lake Reg. Board
- 6.0352 FLOOD PLAIN ANALYSIS AND DISASTER PRE-
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FLOODS

- 6.0354 DEVELOPMENT IN FLOOD-PRONE AREAS OF LINCOLN COUNTY, OREGON AUGUST, 1973
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- 6.0362 FLOOD CONTROL STUDY OF RIO GRANDE DE MANATI, MANATI AND BARCELONETA, PUERTO RICO
UNKNOWN, State Planning Board
- 6.0363 MYRTLE BEACH, S.C. - COMPREHENSIVE DEVELOPMENT PLAN
UNKNOWN, State Planning & Grants Div.
- 6.0369 ZONING ORDINANCE, HUNTINGDON, TENNESSEE
UNKNOWN, State Planning Commission
- 6.0380 OSO CREEK TECHNICAL ASSISTANCE STUDY - PRELIMINARY STUDY ON THE PROBLEMS AND OPPORTUNITIES FOR DEVELOPMENT OF OSO CREEK AND OSO BAY
UNKNOWN, U.S. Coastal Bend Reg. Comm.
- 6.0381 SOIL AND WATER CONSERVATION NEEDS INVENTORY, COOKE, GRAYSON AND FANNIN COUNTIES, TEXAS
UNKNOWN, Texoma Regional Planning Comm.
- 6.0385 PALACIOS COMPREHENSIVE PLAN - PHASE 2 - SUMMARY REPORT
G.L. WILLIAMS, Lockwood Andrews & Newman Inc.

U.S. DEPT. OF INTERIOR - ILL RECLAMATION

- 6.0171 CLOUD SEEDING POTENTIAL FOR TWELVE RIVER BASINS
R.D. ELLIOTT, North Amer. Weather Consult
- 6.0183 FLOOD HYDROLOGY INVESTIGATIONS
F.A. BERTLE, U.S. Dept. of the Interior, Bureau of Reclamation

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- 6.0015 ANALYSIS OF COAL REFUSE DAM FAILURE MIDDLE FORK BUFFALO CREEK, SAUNDERS, WEST VIRGINIA - VOLUME I
UNKNOWN, W.A. Wahler & Associates
- 6.0040 ANALYSIS OF COAL REFUSE DAM FAILURE MIDDLE FORK BUFFALO CREEK, SAUNDERS, WEST VIRGINIA - VOLUME II, APPENDICES
UNKNOWN, W.A. Wahler & Associates

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- 6.0020 FLOOD OF JULY 17, 1972 IN GALLUP, NEW MEXICO
L.A. WAITE, U.S. Dept. of the Interior, Geological Survey
- 6.0023 FLOOD FREQUENCY AND HIGH FLOW STUDIES
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0034 FLOOD-FREQUENCY SYNTHESIS FOR SMALL STREAMS - ALABAMA
C.O. MING, U.S. Dept. of the Interior, Geological Survey

- 6.0048 FLOOD FREQUENCY IN URBAN AREAS - COLORADO
G.L. DUCRET, U.S. Dept. of the Interior, Geological Survey
- 6.0049 PEAK DISCHARGE AND FREQUENCY OF SMALL WATERSHEDS IN COLORADO
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- 6.0058 FLOOD FLOWS FROM SMALL DRAINAGE AREAS
J.D. CAMP, U.S. Dept. of the Interior, Geological Survey
- 6.0062 FLOW REGULATION EFFECTS AT BURLINGTON RESERVOIR FROM DOWNSTREAM TO WESTHOPE, NORTH CAROLINA
J.O. SHEARMAN, U.S. Dept. of the Interior, Geological Survey
- 6.0063 FLOOD CHARACTERISTICS OF SMALL DRAINAGE AREAS, IDAHO
C.A. THOMAS, U.S. Dept. of the Interior, Geological Survey
- 6.0067 HYDROLOGIC AND BIOLOGIC STUDIES OF THE SOUTHWEST FLORIDA (BIG CYPRESS) WATERSHED
H. KLEIN, U.S. Dept. of the Interior, Geological Survey
- 6.0068 RESPONSE OF WATER LEVELS TO FLOOD CONTROL OPERATIONS IN SOUTH FLORIDA
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- 6.0069 HYDROLOGIC BASE FOR WATER RESOURCES MANAGEMENT, DADE COUNTY, FLORIDA
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0071 ESTUARINE HYDROLOGY OF TAMPA BAY
C.R. GOODWIN, U.S. Dept. of the Interior, Geological Survey
- 6.0075 FLOOD HYDROLOGY ON SMALL DRAINAGE AREAS IN GEORGIA
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- 6.0079 FLOOD INVESTIGATIONS FOR SMALL DRAINAGE AREAS IN IDAHO
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0082 FLOOD FLOWS FROM SMALL DRAINAGE BASINS IN ILLINOIS
G.W. CURTIS, U.S. Dept. of the Interior, Geological Survey
- 6.0090 STREAMFLOW CHARACTERISTICS, KANSAS
R. HEDMAN, U.S. Dept. of the Interior, Geological Survey
- 6.0091 FLOOD INVESTIGATIONS - HIGHWAY 100 - KANSAS
H.R. HEHL, U.S. Dept. of the Interior, Geological Survey
- 6.0093 FLOOD-FREQUENCY STUDY - KENTUCKY
C.H. HANNUM, U.S. Dept. of the Interior, Geological Survey
- 6.0094 FLOOD FREQUENCY OF SMALL DRAINAGE AREAS IN LOUISIANA
UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0102 FLOODS FROM SMALL DRAINAGE AREAS IN MISSISSIPPI

SUPPORTING ORGANIZATION

- C.G. JOHNSON, U.S. Dept. of the Interior, Geological Survey
- 6.0114 BRIDGE SITE INVESTIGATIONS
C.H. TATE, U.S. Dept. of the Interior, Geological Survey
- 6.0115 SPECIAL FLOOD REPORTS - MISSISSIPPI
C.H. TATE, U.S. Dept. of the Interior, Geological Survey
- 6.0129 INVESTIGATION AND ANALYSIS OF FLOODS FOR SMALL DRAINAGE AREAS IN NEW MEXICO
A.G. SCOTT, U.S. Dept. of the Interior, Geological Survey
- 6.0134 EFFECTS OF URBANIZATION ON FLOODS AT WINSTON-SALEM, NORTH CAROLINA
A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey
- 6.0135 EFFECTS OF URBANIZATION ON FLOODS AT DURHAM, NORTH CAROLINA
A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey
- 6.0136 EFFECTS OF URBANIZATION ON FLOODS AT LENOIR, NORTH CAROLINA
A.L. PUTNAM, U.S. Dept. of the Interior, Geological Survey
- 6.0138 MAGNITUDE AND FREQUENCY OF FLOOD DISCHARGES FROM SMALL DRAINAGE BASINS, EFFECTS OF DRAINAGE BASIN CHARACTERISTICS - NORTH DAKOTA
O.A. CROSBY, U.S. Dept. of the Interior, Geological Survey
- 6.0139 STATEWIDE FLOOD-FREQUENCY REPORT - OKLAHOMA
V.B. SAUER, U.S. Dept. of the Interior, Geological Survey
- 6.0140 INVESTIGATION AND ANALYSIS OF FLOODS FROM SMALL WATERSHEDS IN OKLAHOMA
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UNKNOWN, U.S. Dept. of the Interior, Geological Survey
- 6.0147 FLOOD INVESTIGATIONS - TENNESSEE
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- 6.0344 MAGNITUDE AND FREQUENCY OF FLOODS IN SMALL STREAMS - NORTH DAKOTA
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- 6.0365 FLOOD FREQUENCY OF SMALL AREAS - SOUTH CAROLINA
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UNKNOWN, Texas A & M University System, Water Resources Institute
- 6.0390 DEFINING THE ELEMENTS OF THE SOIL CAL. SYSTEM RELATED TO DRAINAGE PROBLEMS OF URBAN AREAS
W.H. ANDREWS, Utah State University, Inst. of Science Res.
- 6.0396 NUMERICAL STUDIES OF UNSTEADY FLOW IN THE JAMES RIVER - VIRGINIA
D.N. CONTRACTOR, Virginia Polytechnic Institute, School of Engineering
- 6.0397 PUBLIC CHOICE AND THE DISTRIBUTION OF BENEFITS AND COSTS OF FLOOD PLAIN PROTECTION - VIRGINIA
L.A. SHABMAN, Virginia Polytechnic Institute, School of Agriculture
- 6.0399 FLOOD DAMAGE ABATEMENT STUDIES IN VIRGINIA
W.R. WALKER, Virginia Polytechnic Institute, Water Resources Research Ctr.
- 6.0410 WATER RESOURCES POLICY IN WISCONSIN - VOLUME IV - FLOOD PLAIN MANAGEMENT
J.A. KUSLER, Univ. of Wisconsin, Water Resources Research Ctr.
- 6.0411 NEW TECHNIQUES FOR DELINEATING FLOOD PLAIN HAZARD ZONES - SOIL SURVEYS
G.B. LEE, Univ. of Wisconsin, Water Resources Research Ctr.
- 6.0412 REMOTE SENSING FOR RESOURCE MANAGEMENT AND FLOOD PLAIN DELINEATION
C.J. MILFRED, Univ. of Wisconsin, School of Agriculture
- 6.0413 THE USE OF DETAILED SOILS INFORMATION FOR DELINEATING AND REGULATING FLOOD PLAINS - LEGAL AND ADMINISTRATIVE CONSIDERATIONS
D.A. YANGGEN, Univ. of Wisconsin, Water Resources Research Center
- U.S. DEPT. OF TRANSPORTATION - F.H.A.
- 6.0043 FLOODS FROM SMALL DRAINAGE AREAS IN CALIFORNIA
A.O. WAANANEN, State Dept. of Transportation
- 6.0050 FLOOD PROTECTION AT CULVERT OUTFALLS
D.B. SIMONS, Colorado State University, School of Engineering
- 6.0059 INVESTIGATION AND ANALYSIS OF FLOODS FROM SMALL DRAINAGE AREAS IN OHIO
W.P. CROSS, U.S. Dept. of the Interior, Geological Survey
- 6.0060 INFLOW HYDROGRAPH STUDY - WYOMING
R. CUSHMAN, U.S. Dept. of the Interior, Geological Survey
- 6.0061 PROGRAM FOR HYDROLOGIC INVESTIGATION OF SMALL DRAINAGE AREAS IN TEXAS
E.E. SCHROEDER, U.S. Dept. of the Interior, Geological Survey
- 6.0065 FLOOD FREQUENCY IN SMALL DRAINAGE AREAS - MISSISSIPPI
K.V. WILSON, U.S. Dept. of the Interior, Geological Survey
- 6.0145 FLOOD PREDICTION METHODS FOR PENNSYLVANIA HIGHWAY CROSSINGS
B.M. REICH, Penn. State University, School of Engineering

- 6.0155 REVIEW EMERGENCY RELIEF FILES AND SURVEY THE TREND OF BRIDGE LOSSES DURING STORM CONDITIONS

F. CHANG, Unknown Inst. or Indiv. Grant

- 6.0208 HYDROLOGIC STUDY OF SMALL RURAL WATERSHEDS - INDIANA

COOK, U.S. Dept. of the Interior, Geological Survey

- 6.0212 INVESTIGATION OF SCOUR AT BRIDGES IN ALASKA

L.S. LEVEEN, U.S. Dept. of the Interior, Geological Survey

- 6.0213 FLOOD FREQUENCY OF ALABAMA STREAMS - ALABAMA

J.F. MCCAIG, U.S. Dept. of the Interior, Geological Survey

- 6.0216 WATER RESOURCES INVESTIGATIONS

V.B. SAUER, U.S. Dept. of the Interior, Geological Survey

- 6.0217 INVESTIGATION ON ANALYSIS OF FLOODS FROM SMALL WATERSHEDS IN OKLAHOMA

W. THOMAS, U.S. Dept. of the Interior, Geological Survey

- 6.0219 INVESTIGATION AND ANALYSIS OF FLOOD HYDROGRAPHS FROM SMALL DRAINAGE BASINS IN SOUTH DAKOTA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey

- 6.0222 INVESTIGATION AND ANALYSIS OF FLOODS FROM SMALL DRAINAGE AREAS IN SOUTH CAROLINA

B.H. WHETSTONE, U.S. Dept. of the Interior, Geological Survey

- 6.0327 FLOOD FREQUENCY STUDY IN NEW MEXICO

UNKNOWN, U.S. Dept. of the Interior, Geological Survey

- 6.0356 COMPARISON OF RECENTLY PUBLISHED FORMULAE FOR FLOOD FREQUENCY IN PENNSYLVANIA

B.M. REICH, Unknown Inst. or Indiv. Grant

U.S. ENVIRON. PROTECT. AGENCY - O.R.M.

- 6.0112 RAINFALL-RUNOFF RELATIONS ON URBAN AND RURAL AREAS

E.F. BRATER, Univ. of Michigan, School of Engineering

U.S. NATL. AERO. & SPACE ADM

- 6.0030 MONITORING FLOOD DAMAGE WITH SATELLITE IMAGERY

L.A. BENSON, South Dakota State University, Remote Sensing Institute

- 6.0209 INVESTIGATION OF ERTS-A IMAGES FOR APPLICATION TO THEMATIC MAPPING, MISSISSIPPI RIVER

D.T. EDSON, U.S. Dept. of the Interior, Geological Survey

- 6.0298 USE OF ERTS-1 DATA - SUMMARY REPORT OF WORK ON TEN TASKS

F.J. THOMSON, Environmental Res. Inst. Mich.

- 6.0393 SURVEY OF LAKE FLOODING FROM ERTS-1 - LAKE CHAMPLAIN

A.O. LIND, Univ. of Vermont, School of Arts

D.C. COX, Univ. of Hawaii, School of Arts

- 6.0259 RESEARCH INITIATION - A MULTIDIMENSIONAL STOCHASTIC MODEL FOR FLOOD PREDICTION

R.B. COROTIS, Northwestern University, School of Technology

U.S. TENNESSEE VALLEY AUTH.

- 6.0367 DEVELOPMENT OF WATER RESOURCE MANAGEMENT METHODS - TENNESSEE

E.H. LESENE, U.S. Tennessee Valley Auth., Div. of Water Cont. Plan.

- 6.0368 BEECH RIVER WATERSHED PROJECT - TENNESSEE

C.H. SMITH, U.S. Tennessee Valley Auth.

U.S. WATER RESOURCES COUNCIL - WASH., D.C.

- 6.0223 STANDARDS FOR PLANNING WATER AND LAND RESOURCES

UNKNOWN, U.S. Water Resources Council

- 6.0224 A UNIFORM TECHNIQUE FOR DETERMINING FLOOD FLOW FREQUENCIES

UNKNOWN, U.S. Water Resources Council

- 6.0225 FLOOD HAZARD EVALUATION GUIDELINES FOR FEDERAL EXECUTIVE AGENCIES

UNKNOWN, U.S. Water Resources Council

- 6.0226 REGULATION OF FLOOD HAZARD AREAS TO REDUCE FLOOD LOSSES - VOLUME I, PARTS I-IV

UNKNOWN, U.S. Water Resources Council

- 6.0227 NEW ENGLAND RIVER BASINS COMMISSION, ANNUAL REPORT, FISCAL YEAR 1971

UNKNOWN, U.S. Water Resources Council

- 6.0228 OHIO RIVER BASIN SURVEY, MAIN REPORT & DEVELOPMENT PROGRAM, COMMUNICATION FROM CHAIRMAN, U. S. WATER RESOURCES COUNCIL (ABBREV)

UNKNOWN, U.S. Water Resources Council

- 6.0350 APPRAISAL OF THE WATER AND RELATED LAND RESOURCES OF OKLAHOMA - REGION EIGHT - 1971

UNKNOWN, State Water Resour. Board

UNIVERSITY OF ALABAMA

- 6.0162 LAND-USE REGULATIONS IN FLOOD-PRONE AREAS - A SUMMARY OF THE WISCONSIN STUDY AND AN ANALYSIS OF ALABAMA LAND-USE LAW

H. COHEN, Univ. of Alabama, Natural Resources Center

UNIVERSITY OF HAWAII

- 6.0077 FLOOD HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII

Y.S. FOK, Univ. of Hawaii, Water Resources Research Ctr.

VIRGINIA POLYTECHNIC INST. - BLACKSBURG

- 6.0012 PROCEEDINGS - COMMUNITY WORKSHOP ON FLOOD INSURANCE
J.E. HACKETT, Virginia Polytechnic Institute, Water Resources Research Ctr.

WASHINGTON STATE GOVERNMENT - OLYMPIA

- 6.0402 PILOT STUDY OF FLOOD PLAIN MANAGEMENT - WASHINGTON
J.F. ORSBORN, Washington State University, School of Engineering

WYOMING STATE GOVERNMENT - CHEYENNE

- 6.0189 INVESTIGATION FOR FLOOD PROTECTION OF BRIDGES
D. SIMONS, Colorado State University, School of Engineering

HAIL

U.S. ATOMIC ENERGY COMMISSION

- 7.0017 TRACER STUDIES IN THE NATIONAL HAIL RESEARCH EXPERIMENT (NHRE)
J.A. YOUNG, Battelle Memorial Institute

U.S. DEPT. OF AGRICULTURE - C.S.R.S.

- 7.0004 SOYBEAN PHYSIOLOGY AND MANAGEMENT
J.J. FORST, Purdue University, Agricultural Experiment Sta.
 7.0006 WEATHER MODIFICATION IN NORTH DAKOTA
W.J. PROMERSHERGER, North Dakota State University, Agricultural Experiment Sta.

U.S. DEPT. OF AGRICULTURE - E.R.S.

- 7.0001 ESTIMATING CROP LOSSES DUE TO HAIL. STATISTICAL SUPPLEMENT TO AGRICULTURAL ECONOMIC REPORT NO. 267
L.M. BOONE, U.S. Dept. of Agriculture, Economic & Stat. Analysis Div.
 7.0002 MEASUREMENT AND ANALYSIS OF FARM RISKS, LOSSES, AND INSURANCE
L.A. JONES, U.S. Dept. of Agriculture, Farm Production Economics Div.
 7.0005 ECONOMIC AND INSTITUTIONAL CONSIDERATIONS OF SUPPRESSING HAIL.

- L. BOONE*, Univ. of Nebraska, U.S.D.A. Nat. Resour. Ec. Div.

U.S. DEPT. OF COMMERCE - N.O.A.A.

- 7.0012 HAIL AND LIGHTNING - COLORADO
H. WEICKMANN, U.S. Dept. of Commerce, Environ. Research Laboratories

U.S. DEPT. OF HOUSING & URRAN DEVELOPMENT

- 7.0009 URBAN GEOLOGY PLAN FOR CALIFORNIA. THE NATURE, MAGNITUDE, & COSTS OF SEISMIC HAZARDS & RECOMMENDATIONS FOR MITIGATION (ABBREV)
J.T. ALFORE, State Div. of Mines & Geology

U.S. NATL. SCIENCE FOUNDATION

- 7.0003 A STUDY OF CROP-HAIL INSURANCE FOR NORTHEASTERN COLORADO WITH REFERENCE TO THE DESIGN OF THE NATIONAL HAIL RESEARCH EXPERIMENT
P.T. SCHICKEDANZ, State Water Survey
 7.0007 ECONOMIC AND INSTITUTIONAL CONSIDERATIONS OF SUPPRESSING HAIL.
L.M. BOONE, U.S. Dept. of Agriculture, Research Service
 7.0008 STUDIES OF HAIL DATA IN 1970-72
S.A. CHANGNON, State Water Survey
 7.0010 NATIONAL HAIL RESEARCH EXPERIMENT REPORT FOR 1973 - COLORADO
J.W. FIROR, Natl. Center For Atmosph. Res.
 7.0011 THE NATIONAL HAIL RESEARCH EXPERIMENT SUMMER 1973 SUMMARY REPORT
UNKNOWN, Natl. Center For Atmosph. Res.

- 7.0013 EXTENDED AREA EFFECTS FROM WEATHER MODIFICATION
L.O. GRANT, Colorado State University, School of Engineering
 7.0014 NATIONAL HAIL RESEARCH EXPERIMENT COLORADO, NEBRASKA, WYOMING
UNKNOWN, U.S. Natl. Science Foundation
 7.0015 DESIGN OF HAIL SUPPRESSION EXPERIMENT IN ILLINOIS
G.M. MORGAN, Univ. of Illinois, School of Lib. Studies
 7.0018 STUDY OF THE FEATURES AND BUDGETS OF NORTHEASTERN COLORADO STORMS - ALSO, WISCONSIN
C.E. ANDERSON, Univ. of Wisconsin, School of Sciences

HURRICANES

NO FORMAL SUPPORT REPORTED

- 8.0026 EVACUATION OF COASTAL RESIDENTS DURING HURRICANES A PILOT STUDY FOR FLORIDA COUNTY, FLORIDA
UNKNOWN, Miami Federal Executive Board

U.S. DEPT. OF COMMERCE - ECON. DEV. ADMIN.

- 8.0011 GRANT TO DESIGN A REBUILDING PLAN FOR

- 8.0012 GRANT TO DESIGN A REBUILDING PLAN FOR GULFPORT, MISSISSIPPI, TO RESTORE THE DAMAGE OF HURRICANE CAMILLE. VOLUMES IV & V (ABBREV)
UNKNOWN, State Res. & Dev. Center

U.S. DEPT. OF COMMERCE - MARITIME ADMIN.

- 8.0076 HURRICANE EFFECTS ON PORT FACILITIES
R.D. MARSHALL, U.S. Dept. of Commerce, Natl. Bureau of Standards

U.S. DEPT. OF COMMERCE - N.O.S.

- 8.0074 HURRICANE CAMILLE - AUGUST 1969
R.D. DIKKERS, U.S. Dept. of Commerce, Building Research Div.

- 8.0077 DESIGN, SITING, AND CONSTRUCTION OF LOW-COST HOUSING AND COMMUNITY BUILDINGS TO BETTER WITHSTAND EARTHQUAKES AND WINDSTORMS
W.F. REPS, U.S. Dept. of Commerce, Center For Building Technology

- 8.0078 WIND AND SURGE DAMAGE DUE TO HURRICANE CAMILLE
H.C. THOM, U.S. Dept. of Commerce, Natl. Bureau of Standards

U.S. DEPT. OF COMMERCE - N.O.A.A.

- 8.0002 COASTAL STORM DAMAGE WITH SPECIAL REFERENCE TO THE DELMARVA REGION OF DELAWARE, MARYLAND, VIRGINIA
F.J. SWAYE, Univ. of Delaware, School of Arts

- 8.0004 FEDERAL PLAN FOR METEOROLOGICAL SERVICES & SUPPORTING RESEARCH - FISCAL YEAR 1974
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

- 8.0005 ATLANTIC HURRICANE SEASON OF 1972
R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service

- 8.0007 THE NATURE AND EXTENT OF STRUCTURAL DAMAGE CAUSED BY HURRICANE CAMILLE
H.S. SAFFIR, Unknown Inst. or Indiv. Grant

- 8.0016 MEMORABLE HURRICANES OF THE UNITED STATES SINCE 1973
A.L. SUGG, U.S. Dept. of Commerce, Natl. Weather Service

- 8.0020 NATIONAL HURRICANE OPERATION PLAN
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

- 8.0021 NATIONAL HURRICANE OPERATIONS PLAN 1974
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic &

- 8.0023 THE HOMEPORT STORY - AN IMAGINARY CITY GETS READY FOR A HURRICANE
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

- 8.0029 WATER WARNINGS AND SPECIALIZED FORECASTS
UNKNOWN, U.S. Air Force, Air Weather Service

- 8.0057 HURRICANE MODIFICATION
R.C. GENTRY, U.S. Dept. of Commerce, Environ. Research Laboratories

- 8.0058 TROPICAL METEOROLOGIC PROBLEMS
R.C. GENTRY, U.S. Dept. of Commerce, Environ. Research Laboratories

- 8.0059 A PRELIMINARY VIEW OF STORM SURGES BEFORE AND AFTER STORM MODIFICATIONS
C.P. JELESNIANSKI, U.S. Dept. of Commerce, Weather Modification Prg. Off.

- 8.0060 STORM SURGE RESEARCH
F. OSTAPOFF, U.S. Dept. of Commerce, Environ. Research Laboratories

- 8.0061 HURRICANE RESEARCH MODELING
S.L. ROSENTHAL, U.S. Dept. of Commerce, Environ. Research Laboratories

- 8.0062 HURRICANE MODELING
S.L. ROSENTHAL, U.S. Dept. of Commerce, Environ. Research Laboratories

- 8.0063 HURRICANE-TYPHOON DYNAMICS
M. SCHERER, U.S. Dept. of Commerce, Environ. Research Laboratories

- 8.0064 HURRICANE-OCEAN INTERACTION
M. SCHERER, U.S. Dept. of Commerce, Environ. Research Laboratories

- 8.0065 SEA-AIR INTERACTION LABORATORY OPERATIONS
H.B. STEWART, U.S. Dept. of Commerce, Environ. Research Laboratories

- 8.0066 INVESTIGATION OF SATELLITE OBSERVED TYPHOON-HURRICANE CLOUD CLUSTERS AND FLOW FEATURES
W.M. GRAY, Colorado State University, School of Engineering

- 8.0068 HURRICANE SPAWNED TORNADOES
D.J. NOVLAN, Colorado State University, School of Engineering

- 8.0069 THE STRUCTURE AND DYNAMICS OF THE HURRICANE'S INNER CORE REGION
D.J. SHEA, Colorado State University, School of Engineering

- 8.0075 A TECHNIQUE FOR THE ANALYSIS AND FORECASTING OF TROPICAL CYCLONE INTENSITIES FROM SATELLITE PICTURES
V.F. DVORAK, U.S. Dept. of Commerce, Natl. Environ. Satellite Serv.

- 8.0086 COMPUTER METHODS APPLIED TO ATLANTIC AREA TROPICAL STORM AND HURRICANE CLIMATOLOGY
J.R. HOPE, U.S. Dept. of Commerce, Natl. Weather Service
- 8.0087 OBJECTIVE ANALYSIS OF SEA SURFACE TEMPERATURES (SST)
B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0088 CIRCULATION FEATURES OF TROPICAL CYCLONES
B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0089 PREDICTION OF HURRICANE DEVELOPMENT AND MOVEMENT WITH A BAROCLINIC MODEL
B.I. MILLER, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0090 GRAPHICAL DISPLAY OF HURRICANE FORECASTS
C.J. NAUMANN, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0091 STATISTICAL-DYNAMICAL PREDICTION OF HURRICANE TRACKS
C.J. NEUMANN, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0092 ERROR ANALYSIS OF HURRICANE FORECASTS
J.M. PELISSIER, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0093 BAROTROPIC PREDICTION OF HURRICANE TRACKS
A.C. PIKE, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0094 LANDFALL ERRORS IN HURRICANE FORECASTS
R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0096 HURRICANE MODIFICATION BY CLOUD SEEDING
M.A. ESTOQUE, Univ. of Miami, School of Marine Science
- 8.0097 GIANT WAVES HIT HAWAII
J. BOTTOMS, U.S. Dept. of Commerce, Natl. Weather Service
- 8.0098 USE OF SATELLITE DATA IN STUDIES OF TROPICAL DISTURBANCES
T. MURAKAMI, Univ. of Hawaii, School of Arts
- 8.0100 PROPOSED CHARACTERIZATION OF TORNADOES AND HURRICANES BY AREA AND INTENSITY
T.T. FUJITA, Univ. of Chicago, School of Physical Sciences
- 8.0105 EXTENDING THE COMPUTERIZED TYPHOON/TROPICAL STORM PREDICTION PROGRAM (TYPHOON 72) TOWARD SEVEN DAYS
UNKNOWN, Ocean Data Systems Inc.
- 8.0106 BENEFITS OF ENVIRONMENTAL PREDICTION IN THE EASTERN GULF OF MEXICO
M.G. JOHNSON, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

- 8.0108 VISUAL, IR, AND DATA COLLECTION ABILITIES OF THE GOES SATELLITE
A.F. FLANDERS, U.S. Dept. of Commerce, Natl. Weather Service
- 8.0109 TROPICAL STORM SURGE FORECASTS
C.P. JELESNIANSKI, U.S. Dept. of Commerce, Development Lab.
- 8.0110 SPECIAL PROGRAM TO LIST AND ANALYZE SURGES FROM HURRICANES - PART I: TROPICAL STORMS
C.P. JELESNIANSKI, U.S. Dept. of Commerce, Development Lab.
- 8.0111 SPECIAL PROGRAM TO LIST AND ANALYZE SURGES FROM HURRICANES - PART II: TRACK AND VARIANT STORM CONDITIONS
C.P. JELESNIANSKI, U.S. Dept. of Commerce, Development Lab.
- 8.0112 JOINT PROBABILITY METHOD OF TROPICAL FREQUENCY ANALYSIS APPLIED TO CITY AND LONG BEACH ISLAND, NEW YORK
V.A. MYERS, U.S. Dept. of Commerce, Natl. Weather Service
- 8.0113 MARINE ENVIRONMENTAL PREDICTION
N.A. PORE, U.S. Dept. of Commerce, Technical Lab.
- 8.0114 SUMMARY OF SELECTED MATERIAL ON THE OCEANIC PHENOMENA OF TIDES, STORM SURGES, AND BREAKERS
N.A. PORE, U.S. Dept. of Commerce, Technical Lab.
- 8.0115 MARINE CONDITIONS AND FORECASTS FOR THE ATLANTIC COAST OF FEBRUARY 18-20, 1972
N.A. PORE, U.S. Dept. of Commerce, Technical Lab.
- 8.0116 FORECASTING EXTRATROPICAL SURGES FOR THE NORTHEAST COAST OF THE UNITED STATES
N.A. PORE, U.S. Dept. of Commerce, Technical Lab.
- 8.0123 PRELIMINARY CLIMATIC DATA FOR HURRICANE AGNES JUNE 14-23, 1972
R.M. DEANGELIS, U.S. Dept. of Commerce, Natl. Hurricane Center
- 8.0124 ALTERNATIVE ADJUSTMENTS TO HAZARDS
D.G. AREY, Univ. of Pittsburgh, Graduate School of Engineering
- 8.0126 ANALYTICAL PHYSICAL MODEL
F.M. WHITE, Univ. of Rhode Island, School of Oceanography
- 8.0127 SOUTH CAROLINA HURRICANE SURGE DESCRIPTIVE LISTING OF TROPICAL STORMS THAT HAVE AFFECTED SOUTH CAROLINA
J.C. PURVIS, U.S. Dept. of Commerce, Natl. Weather Service
- 8.0128 INVESTIGATION OF SHORELINE CHANGES AT SARGENT BEACH, TEXAS
UNKNOWN, U.S. Dept. of Commerce, Natl. Weather Service

W.N. SEELIG, Texas A & M University System, Graduate School

8.0129 OBJECTIVE ANALYSIS OF THE SEA SURFACE TEMPERATURE

B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Weather Service

8.0130 A DECISION PROCEDURE FOR APPLICATION IN PREDICTING THE LANDFALL OF HURRICANES

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service

8.0131 THE DECISION PROCESS IN HURRICANE FORECASTING

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service

8.0132 ATLANTIC HURRICANE FREQUENCIES ALONG THE U.S. COASTLINE

R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service

U.S. DEPT. OF DEFENSE - AIR FORCE

8.0071 A SURVEY OF AVAILABILITY OF HURRICANE/TYPHOON PACKAGES AND ASSOCIATED DATA

A.R. MEALS, U.S. Air Force, Environ. Tech. Appl. Center

U.S. DEPT. OF DEFENSE - ARMY

8.0003 EFFECTS OF TROPICAL STORM AGNES ON THE CHESAPEAKE BAY

D. CORRELL, Smithsonian Institution

8.0013 TEXAS COAST HURRICANE SURGE MODEL STUDIES

N.J. BROGDON, U.S. Army, Estuaries Division

8.0014 SURVEY OF GULF COAST STRUCTURAL DAMAGE RESULTING FROM HURRICANE CAMILLE, AUGUST 1969

M.E. CRISWELL, U.S. Army, Waterways Experiment Station

8.0017 NATURAL DISASTERS OPERATIONS PLANNING FOR SLOWLY DEVELOPING DISASTERS, VOLUME I

A. SACHS, Inst. For Defense Analysis

8.0019 CONCRETE BLOCK REVETMENT NEAR BENEDICT, MARYLAND

J.V. HALL, U.S. Army, Coastal Engin. Res. Center

8.0025 BAY HARBOR, FLORIDA PARTIAL BEACH RESTORATION, BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT, OADE COUNTY, FLORIDA

UNKNOWN, U.S. Army, Engineer District

8.0028 Jekyll Island, Georgia, Beach Erosion Control and Hurricane Protection

UNKNOWN, U.S. Army, Engineer District

8.0030 GRAND ISLE, LOUISIANA, AND VICINITY HURRICANE PROTECTION ASSOCIATED WATER FEATURE, BAYOU LAFOURCHE - LOUISIANA (ABBREV)

8.0032 LAKE PONCHARTRAIN, LOUISIANA AND VICINITY - HURRICANE PROTECTION PROJECT

UNKNOWN, U.S. Army, Engineer District

8.0033 MORGAN CITY, LOUISIANA, AND VICINITY (FRANKLIN AND VICINITY AREA)

UNKNOWN, U.S. Army, Engineer District

8.0034 HURRICANE PROTECTION PROJECT, STRATFORD, CONNECTICUT

UNKNOWN, U.S. Army, New England Division

8.0035 OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, MASSACHUSETTS

UNKNOWN, U.S. Army, New England Division

8.0036 OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, NEW BEDFORD, MASSACHUSETTS

UNKNOWN, U.S. Army, New England Division

8.0037 NEW LONDON HURRICANE PROTECTION PROJECT, NEW LONDON, CONNECTICUT

UNKNOWN, U.S. Army, New England Division

8.0038 GALVESTON BAY HURRICANE SURGE - REPORT 2. EFFECTS OF PROPOSED BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV)

W.H. BOBB, U.S. Army, Waterways Experiment Station

8.0039 GALVESTON BAY HURRICANE SURGE - REPORT 3 - EFFECTS OF BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV)

W.H. BOBB, U.S. Army, Waterways Experiment Station

8.0040 GALVESTON BAY HURRICANE SURGE STUDY - BARRIERS ON HURRICANE SURGE HEIGHTS - HYDRAULIC MODEL INVESTIGATION

N.J. BROGDON, U.S. Army, Waterways Experiment Station

8.0041 WAVE AND SURGE CONDITIONS AFTER PROPOSED EXPANSION OF MONTEREY HARBOR, MONTEREY, CALIFORNIA - HYDRAULIC MODEL INVESTIGATION

C.E. CHATHAM, U.S. Army, Waterways Experiment Station

8.0042 WAVE AND SURGE ACTION, MONTEREY HARBOR, MONTEREY, CALIFORNIA - MODEL INVESTIGATION

E.P. FORTSON, U.S. Army, Waterways Experiment Station

8.0043 DISCHARGE CHARACTERISTICS OF HURRICANE BARRIERS, WARHAMMARION, MASSACHUSETTS - HYDRAULIC MODEL INVESTIGATION

E.C. MCNAIR, U.S. Army, Waterways Experiment Station

8.0044 DISCHARGE CHARACTERISTICS OF HURRICANE BARRIER, EAST PASSAGE OF NARRAGANSETT BAY, RHODE ISLAND - HYDRAULIC MODEL INVESTIGATION

G.A. PICKERING, U.S. Army, Waterways Experiment Station

8.0045 GALVESTON BAY HURRICANE SURGE - REPORT 1 - EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS (ABBREV)

R.A. SAGER, U.S. Army, Waterways Experiment Station

8.0046 GALVESTON BAY HURRICANE SURGE - REPORT 2 - EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS (ABBREV)

- 8.0133 SEDIMENT MOVEMENT AND HILLSLOPE MORPHOLOGY IN THE CENTRAL APPALACHIAN REGION - VIRGINIA
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

U.S. DEPT. OF TRANSPORTATION - COAST GUARD

- 8.0006 APPLICATION OF ECONOMIC ANALYSES TO HURRICANE WARNINGS TO RESIDENTIAL AND RETAIL ACTIVITIES IN THE U. S. GULF OF MEXICO COASTAL REGION
L.G. ANDERSON, Univ. of Miami, School of Marine Science

U.S. NATL. AERO. & SPACE ADM.

- 8.0024 KENNEDY SPACE CENTER OCEAN BEACH EROSION - FLORIDA
A.J. MEHTA, Univ. of Florida, School of Engineering
- 8.0083 HURRICANE PREPAREDNESS AND CONTROL PLAN
UNKNOWN, U.S. Natl. Aero. & Space Adm., John F. Kennedy Space Center
- 8.0104 MICROWAVE METEOROLOGY
J.L. KING, U.S. Natl. Aero. & Space Adm., Goddard Space Flight Center
- 8.0122 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES (FOR SELECTED STATIONS AND THE MONTH OF SEPTEMBER)
H.L. CRUTCHER, U.S. Dept. of Commerce, Natl. Climatic Center

U.S. NATL. SCIENCE FOUNDATION

- 8.0009 ASSESSMENT OF THE PHYSICAL AND GEOLOGICAL EFFECTS OF TROPICAL STORM AGNES ON THE UPPER CHESAPEAKE BAY AND SELECTED TRIBUTARIES
J.R. SCHUBEL, Johns Hopkins University, Graduate School
- 8.0067 STUDIES OF CUMULUS HEATING AND THE CISK MECHANISM
W.M. GRAY, Colorado State University, School of Engineering
- 8.0095 PROJECT STORMFURY ANNUAL REPORT 1971
UNKNOWN, U.S. Dept. of Commerce, Natl. Hurricane Res. Lab.
- 8.0099 THEORETICAL ANALYSIS OF LARGE-SCALE TROPICAL DISTURBANCES
T. MURAKAMI, Univ. of Hawaii, School of Arts
- 8.0102 PROBABILISTIC ANALYSIS OF ELASTO-PLASTIC STRUCTURES
T.L. PAEZ, Purdue University, School of Civil Engin.
- 8.0120 MICRO AND MESOSCALE GEOPHYSICAL FLUID DYNAMICS
Y. KURIHARA, Princeton University, Graduate School
- 8.0125 NUMERICAL STUDIES OF RAINBAND CIRCULATIONS IN TROPICAL CYCLONES

- 8.0137 ENERGY, MASS AND ANGULAR MOMENTUM BUDGETS OF EXTRATROPICAL CYCLONES
D.R. JOHNSON, Univ. of Wisconsin, Graduate School
- 8.0138 NUMERICAL STUDIES IN THE CIRCULATION OF STORM SURGES IN LAKE ONTARIO
D.B. RAO, Univ. of Wisconsin, School of Letters

UNIVERSITY OF ILLINOIS

- 8.0101 PROBABILISTIC MODELING OF LOADS
Y.K. WEN, Univ. of Illinois, School of Engineering

LAND SLIDES

CALIFORNIA STATE GOVERNMENT - SACRAMENTO

- 9.0006 SUBAUDIBLE ROCK NOISE (SARN) AND ASSURANCE OF SLOPE STABILITY, CALIFORNIA
R. MEARNES, State Div. of Highways

ILLINOIS STATE GOVERNMENT - SPRINGFIELD

- 9.0011 ENGINEERING GEOLOGY - ILLINOIS
W.C. SMITH, State Geol. Survey

KENTUCKY STATE GOVERNMENT - FRANKFORT

- 9.0015 LANDSLIDES - KENTUCKY
C.T. GORMAN, State Bur. of Highways

MICHIGAN STATE GOVERNMENT - LANSING

- 9.0016 SLOPE STABILITY OF CUTS IN ONONDAGA CLAY
L.A. ALNOURI, State Dept. of Highways

NATL. ACADEMY OF SCIENCES - WASHINGTON

- 9.0010 SHEAR STRENGTH OF FINE-GRAINED SOILS
WEST POINT, NEW YORK
UNKNOWN, Transportation Res. Board

OHIO STATE GOVERNMENT - COLUMBUS

- 9.0057 LANDSLIPS IN SOUTHEASTERN OHIO
K.R. EVERETT, Ohio State University, School of Geology
- 9.0059 STABILIZATION OF STEEP LANDS IN OHIO
G.O. SCHWAB, Ohio State University, School of Geology

OHIO STATE UNIVERSITY

SHALLOW TILL SOILS OF SOUTHEAST ALASKA
D.N. SWANSTON, U.S. Dept. of Agriculture, Pac. N.W.
For. & Rg. Exp. Sta.

- 9.0062 EROSION AND SEDIMENTATION FOLLOWING
ROAD CONSTRUCTION AND TIMBER HARVEST ON
UNSTABLE SOILS IN THREE SMALL WESTERN
OREGON WATERSHEDS

R.L. FREDRIKSEN, U.S. Dept. of Agriculture, Pac. N.W.
For. & Rg. Exp. Sta.

U.S. DEPT. OF DEFENSE - AIR FORCE

- 9.0017 CLAY MOBILITY IN RIDGE ROUTE LAND-
SLIDES, GORMAN, CALIFORNIA

P.F. KERR, Columbia University, School of Arts

- 9.0056 THE INFLUENCE OF CLAY MINERALS ON SUR-
FICIAL EARTH MOVEMENTS

P.F. KERR, Columbia University, School of Arts

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- 9.0003 MOBILIZATION OF DEBRIS FLOWS 9973-EN

A.M. JOHNSON, Stanford University, School of Earth
Sciences

- 9.0021 ROCK STRENGTH FROM FAILURE CASES -
POWERHOUSE SLOPE STABILITY STUDY, FORT
PECK DAM, MONTANA

J.V. HAMMEL, Hammel Geotechnical Consultants

- 9.0054 ROCK STRENGTH FROM FAILURE CASES

J.F. REDLINGER, U.S. Army, Missouri River Engr. Div.

U.S. DEPT. OF DEFENSE - NAVY

- 9.0004 GENERAL REVIEW OF THE SEISMIC HAZARD
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J.B. SEED, Calif. Inst. of Technology, Graduate School

- 9.0036 DEFORMATION CHARACTERISTICS OF HILL
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RETURNS - CALIFORNIA

D.H. POOLE, Univ. of California, School of Physical
Sciences

- 9.0063 DEVELOPMENT OF CRITERIA FOR RECOGNIZ-
ING & IDENTIFYING SLOPE FAILURE FORMS AS
DEPICTED BY REMOTE SENSOR RETURNS - NORTH
CAROLINA

D.H. POOLE, East Tenn. State University, Remote Sensing
Institute

U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

- 9.0007 URBAN GEOLOGY PLAN FOR CALIFORNIA -
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IC HAZARDS & RECOMMENDATIONS FOR THEIR
MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology

U.S. DEPT. OF INTERIOR - BU. RECLAMATION

- 9.0008 RIPRAP SLOPE PROTECTION FOR
DAMS - A REVIEW OF PRACTICE
PROCEDURES

F.J. DAVIS, U.S. Dept. of the Interior, Bureau
of Reclamation

- 9.0047 EVALUATION OF CRITERIA FOR
ANALYSIS AS PRESENTED IN THE U.S.G.

UNKNOWN, U.S. Dept. of the Interior, Bureau
of Reclamation

U.S. DEPT. OF INTERIOR - BUREAU OF LAND MANAGEMENT

- 9.0009 LOCATION OF SLOPE FAILURE PLACES

R.H. MERRILL, U.S. Dept. of the Interior,
Bureau of Land Management

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- 9.0001 REGIONAL GEOLOGIC FRAMEWORK OF
DREAS FAULT, CALIFORNIA

T.W. DIBBLEE, U.S. Dept. of the Interior, Geo-
logical Survey

- 9.0002 REGIONAL SLOPE STABILITY STUDY
CALIFORNIA AND PENNSYLVANIA

D.H. RADBRUCHI, U.S. Dept. of the Interior,
Geological Survey

- 9.0027 SANTA CRUZ COUNTY COOP

E.E. BRABB, U.S. Dept. of the Interior, Geo-
logical Survey

- 9.0028 EARTHQUAKE HAZARD REDUCTION
SAN FRANCISCO BAY REGION

E.E. BRABB, U.S. Dept. of the Interior, Geo-
logical Survey

- 9.0029 GEOLOGY OF THE POINT DUME
GLE AND THE LOS ANGELES COUNTY
THE TRIUNFO PASS QUADRANGLE, LOS
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R.H. CAMPBELL, U.S. Dept. of the Interior,
Geological Survey

- 9.0030 MONTEREY BAY - CALIFORNIA

H.G. GREENE, U.S. Dept. of the Interior, Geo-
logical Survey

- 9.0031 ALASKA GEOLOGIC EARTHQUAKE
HAZARD

G. PLAFKER, U.S. Dept. of the Interior, Geo-
logical Survey

- 9.0032 GEOLOGY OF THE POINT BONITA
GLE, CALIFORNIA

J. SCHLOCKER, U.S. Dept. of the Interior, Geo-
logical Survey

- 9.0033 ACTIVE FAULTS AND GEOLOGIC
HAZARD - PT. MUGU TO WILMINGTON, CALIFORNIA

H.C. WAGNER, U.S. Dept. of the Interior, Geo-
logical Survey

- 9.0034 MALIBU BEACH QUADRANGLE
UNINCORPORATED PART OF THE
QUADRANGLE, LOS ANGELES COUNTY
CALIFORNIA

- R.F. YERKES*, U.S. Dept. of the Interior, Geological Survey
- 9.0040** SOCORRO 2 DEGREE QUADRANGLE - NEW MEXICO
G.O. BACHMAN, U.S. Dept. of the Interior, Geological Survey
- 9.0041** GEOLOGY OF THE RAPID CITY AREA, SOUTH DAKOTA
J.M. CATTERMOLE, U.S. Dept. of the Interior, Geological Survey
- 9.0042** DENVER METROPOLITAN AREA, COLORADO
R.M. LINDVALL, U.S. Dept. of the Interior, Geological Survey
- 9.0043** SURFICIAL GEOLOGY OF JUNEAU AND VICINITY URBAN AREA, ALASKA
R.D. MILLER, U.S. Dept. of the Interior, Geological Survey
- 9.0044** DENVER FRONT RANGE URBAN CORRIDOR
T.W. OFFIELD, U.S. Dept. of the Interior, Geological Survey
- 9.0045** MOUNTAIN SOILS, FRONT RANGE URBAN CORRIDOR
K.L. PIERCE, U.S. Dept. of the Interior, Geological Survey
- 9.0046** SNAKE RIVER BASIN, PART F - SOUTHERN PART, NORTHWEST MARGIN - IDAHO
B. SKIPP, U.S. Dept. of the Interior, Geological Survey
- 9.0048** HAMILTON 2 DEGREE
J.D. WELLS, U.S. Dept. of the Interior, Geological Survey
- 9.0049** PROGRAM DESIGN-1971 - SAN FRANCISCO BAY REGION ENVIRONMENT AND RESOURCES PLANNING STUDY
UNKNOWN, U.S. Dept. of the Interior, Geological Survey

U.S. DEPT. OF INTERIOR - O.W.R.T.

- 9.0053** ACKER LAKE LANDSLIDE, MONROE COUNTY, MISSISSIPPI
D.M. KEADY, State Geol. Survey

U.S. DEPT. OF TRANSPORTATION - F.H.A.

- 9.0005** EARTHWORK REINFORCEMENT TECHNIQUES - LOS ANGELES AREA
R.A. FORSYTH, State Div. of Highways
- 9.0013** WATER DRAINAGE FROM IN-PLACE FILLS TO PREVENT OR HALT FILL
P.C. CLARK, State Highway Commission
- 9.0014** INVESTIGATION OF LANDSLIDES ON HIGHWAYS
J.H. HAVENS, State Div. of Res.
- 9.0019** SLOPE STABILITY OF CERTAIN SELECTED COLLUVIAL SOILS
C.J. HAYES, State Dept. of Highways
- 9.0037** LIME SOIL STABILIZATION STUDY
R.A. FORSYTH, State Div. of Highways
- 9.0038** EVALUATION OF 'ION EXCHANGE' LANDSLIDE CORRECTION TECHNIQUE - CALIFORNIA

- 9.0061** MEASURE AND DEPICT TROUBLE
STEREO-MODELS - OHIO
W.F. NORELL, State Dept. of Transportation

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- 9.0018** INVESTIGATION OF RED RIVER GEOLOGY - EFFECTS ON STRUCTURE I PERFORMANCE
D.K. LEER, State Highway Department
- 9.0022** LANDSLIDE STUDIES IN SOUTH DA
PORT NO.1 - LOCATION OF AREAS
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J. SCULLY, State Geol. Survey

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- 9.0035** REMOTE SENSING FOR GEOLOGI
AND DISASTERS, MINE AREA CON
SOIL MAPPING AND LAND USE PLANN
G. GOODWIN, U.S. Natl. Aero. & Space
Research Center
- 9.0050** REMOTE SENSING APPLICA
HYDROLOGY AND GEOLOGY
J. DENOYER, U.S. Natl. Aero. & Space Ad
ters

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- 9.0020** FLOW SLIDE CONTROL WITH SLA
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W.L. SCHROEDER, Oregon State University,
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- 9.0025** COLLABORATIVE RESEARCH ON S
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J.K. MITCHELL, Univ. of California, School o
- 9.0051** EFFECTS OF DEFORESTATION ON
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D.H. GRAY, Univ. of Michigan, School of Eng
- 9.0052** EFFECTS OF FOREST CLEAR-CUTTE
STABILITY OF NATURAL SLOPES
D.H. GRAY, Univ. of Michigan, School of Eng
- 9.0055** TREE-RING DATING & SPATIAL A
LONG-TERM SLOPE MOVEMENTS - UTA
J.F. SHRODER, Univ. of Nebraska, School of
- 9.0060** ENVIRONMENTAL INFLUENCES ON
OF SOIL MASSES - ALASKA AND OHIO
T.H. WU, Ohio State University, School of Eng

UNIVERSITY OF ILLINOIS

- 9.0012** STRESS-STRAIN-TIME BEHAVIOR O
ROCK UNDER TRIAXIAL CONDITIONS
G. MESRI, Univ. of Illinois, School of Engine

LAND SUBSIDENCE

FLORIDA STATE GOVERNMENT - TALLAHASSEE

10.0028 SUBSIDENCE INVESTIGATIONS ON ORGANIC SOILS

B.G. VOLK, Agric. Res. & Educ. Center

U.S. DEPT. OF DEFENSE - ARMY

10.0009 DETECTION OF SUBSURFACE OPENINGS - INDIANA, MISSOURI

E.R. BATES, U.S. Army, Waterways Experiment Station

10.0010 STUDY OF GROUND SHOCK INDUCED LIQUEFACTION AS A MECHANISM FOR FAILURE OF MILITARY INSTALLATIONS

J.G. JACKSON, U.S. Army, Waterways Experiment Station

10.0030 VERIFICATION OF EMPIRICAL METHOD OF DETERMINING RIVERBANK STABILITY (POTAMOLGY INVESTIGATIONS - SOILS PHASE)

C.C. CALHOUN, U.S. Army, Waterways Experiment Station

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10.0002 GENERAL REVIEW OF THE SEISMIC HAZARD TO SELECTED U.S. NAVY INSTALLATIONS

J.B. SEED, Calif. Inst. of Technology, Graduate School

10.0025 STUDIES ON THE FLUVIAL ENVIRONMENT, ARCTIC COASTAL PLAIN PROVINCE, NORTHERN ALASKA VOLUME I

R.I. LEWELLEN, Arctic Inst. of North America

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10.0003 URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology

10.0033 DEMONSTRATION OF A TECHNIQUE FOR LIMITING THE SUBSIDENCE OF LAND OVER ABANDONED MINES ROCK SPRINGS, WYOMING

UNKNOWN, Unknown Inst. or Indiv. Grant

U.S. DEPT. OF INTERIOR - BUREAU OF MINES

10.0005 DEVELOP METHODS FOR PREDICTING THE COMPONENTS OF GROUND MOVEMENT ABOVE MINE WORKINGS

D.Q. FLETCHER, U.S. Dept. of the Interior, Bureau of Mines

10.0006 MICROSEISMIC DETERMINATION OF COAL MINE ENTRY STABILITY

R.D. MUNSON, U.S. Dept. of the Interior, Bureau of Mines

10.0007 ROCK MECHANICS STUDY OF SHORTWALL MINING - KENTUCKY

10.0023 ESTABLISH TECHNIQUES FOR SURFACE SUBSIDENCE OVER MINED AREA

W.J. TESCH, U.S. Dept. of the Interior, Bureau of Mines

10.0024 MEASUREMENT AND EVALUATION OF SUBSIDENCE OVER A COAL MINE WITH OVERBURDEN THICKNESS

W.N. YOUNGS, U.S. Dept. of the Interior, Bureau of Mines

U.S. DEPT. OF INTERIOR - GEOLOGICAL SURVEY

10.0004 COAL MINE DEFORMATION STUDIES - COLORADO

C.R. DUNN, U.S. Dept. of the Interior, Geological Survey

10.0011 LAND-SURFACE SUBSIDENCE, AREA, TEXAS

R.K. GABRYSCH, U.S. Dept. of the Interior, Geological Survey

10.0012 LAND-SURFACE SUBSIDENCE, TARRANT AND SEABROOK AREAS, TEXAS

R.K. GABRYSCH, U.S. Dept. of the Interior, Geological Survey

10.0013 CONTINUING QUANTITATIVE WATER STUDIES IN THE HOUSTON DISTRICT

A.G. WINSLOW, U.S. Dept. of the Interior, Geological Survey

10.0015 MASS PROPERTIES OF OIL FIELDS - CALIFORNIA

L.A. BEYER, U.S. Dept. of the Interior, Geological Survey

10.0016 ALASKA GEOLOGIC EARTHQUAKE STUDIES

G. PLAFKER, U.S. Dept. of the Interior, Geological Survey

10.0017 SUBSIDENCE AND RELATED PROBLEMS OF GEOTHERMAL SYSTEMS

B.E. LOFGREN, U.S. Dept. of the Interior, Geological Survey

10.0018 LAND-SUBSIDENCE STUDIES IN COLORADO TO STUDY THE EXTENT, MAGNITUDE, AND CAUSES

J.F. POLAND, U.S. Dept. of the Interior, Geological Survey

10.0019 LAND SUBSIDENCE STUDIES IN JOAQUIN VALLEY - CALIFORNIA

J.F. POLAND, U.S. Dept. of the Interior, Geological Survey

10.0020 DENVER URBAN CORRIDOR STUDIES - COLORADO

W.R. HANSEN, U.S. Dept. of the Interior, Geological Survey

10.0021 ENGINEERING GEOLOGY RECONSTRUCTION STUDIES OF COASTAL COMMUNITIES, ALABAMA

R.W. LEMKE, U.S. Dept. of the Interior, Geological Survey

10.0029 REMOTE SENSING, ALAFIA RIVER BASINS, FLORIDA

A.E. COKER, U.S. Dept. of the Interior, Geological Survey

10.0008 STATUS OF LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL IN MISSISSIPPI
D.M. KEADY, Mississippi St. University, School of Arts

U.S. DEPT. OF TRANSPORTATION - F.H.A.

- 10.0014 ARIZONA EARTH FISSURE INVESTIGATION
C. WINIKKA, State Highway Department
- 10.0027 EARLY DETECTION AND CORRECTION OF SINKHOLE PROBLEMS - ALABAMA
J.G. NEWTON, U.S. Dept. of the Interior, Geological Survey
- 10.0031 MEASURE AND PICTORIAL TROUBLE AREAS IN STEREO-MODELS - OHIO
W.F. NORELL, State Dept. of Transportation

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- 10.0026 RETURNING UNDERGROUND COAL MINE WASTES TO MINED-OUT VOIDS
R.A. CARPENTER, Natl. Acad. of Sciences
- 10.0032 CONTROL OF LAND SUBSIDENCE IN THE TEXAS GULF COAST AREA
A.P. DELFLACHIE, Lamar University, School of Engineering

SNOWSTORMS

U.S. DEPT. OF COMMERCE - N.O.A.A.

- 11.0003 THE MODIFICATION OF GREAT LAKES WINTER STORMS
H.K. WEICKMANN, U.S. Dept. of Commerce, Atmospheric Phys. & Chem. Lab.
- 11.0004 NATIONAL EAST COAST WINTER STORMS OPERATIONS PLAN
UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.
- 11.0005 SNOW FORECASTING FOR SOUTHEASTERN WISCONSIN
R.W. HARMS, U.S. Dept. of Commerce, Natl. Weather Service
- 11.0006 A SYNOPTIC CLIMATOLOGY FOR SNOWSTORMS IN NORTHWESTERN NEVADA
B.L. NELSON, U.S. Dept. of Commerce, Natl. Weather Service
- 11.0009 FREQUENCY AND INTENSITY OF FREEZING RAIN/DRIZZLE IN OHIO
M.F. MILLER, U.S. Dept. of Commerce, Weather Bureau

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11.0002 SNOW AND ICE DETECTION AND SYSTEMS
A.I. MCCONE, M.B. Associates

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- 11.0007 PHYSICAL EVALUATION OF CLOSURE TECHNIQUES FOR MODIFYING CASCADING SNOWFALL - THE CASCADE PROJECT
P.V. HOBBS, Univ. of Washington, School of Engineering
- WYOMING STATE GOVERNMENT - CHIEF OF ENGINEERING
- 11.0008 DETERMINATION OF SNOW FENESTRATION CRITERIA, AND DEVELOPMENT OF A METHOD FOR SNOW CONTROL
R.D. TABLER, Rocky Mtn. Forest & Range Station

TORNADOES

ILLINOIS STATE GOVERNMENT - SPRINGFIELD

- 12.0017 DENSE RAIN GAGE NETWORK PROJECT - ILLINOIS
S.A. CHANGNON, State Water Survey
- 12.0033 HYDROMETEOROLOGICAL ANALYSIS OF SEVERE RAINSTORMS - ILLINOIS
F.A. HUFF, State Water Survey
- 12.0034 STUDY OF THE SYNOPTIC CLIMATE OF NORTH AMERICA
G. MORGAN, State Water Survey

TEXAS TECHNOLOGICAL UNIVERSITY - LUBBOCK

- 12.0002 TORNADO - THE VOICE OF THE DISASTER AND AFTER - A STUDY IN RESEARCH INTEGRATION - TEXAS (LUBBOCK?)
M.S. MINNIS, Texas Technological University, School of Arts

U.S. DEPT. OF COMMERCE - F.S.S.

- 12.0038 BEHAVIOR OF WINDS IN THE LOW LEVELS OF THE ATMOSPHERE - JUNE 1967
K.C. CRAWFORD, U.S. Dept. of Commerce, Natl. Weather Service, Storms Lab.

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- 12.0001 DISASTER INVESTIGATIONS
C.G. CULVER, U.S. Dept. of Commerce, Natl. Bureau of Standards
- 12.0004 LUBBOCK TORNADO - A SURVEY OF THE DAMAGE IN AN URBAN AREA - TEXAS

12.0005 FEDERAL PLAN FOR METEOROLOGICAL SERVICES & SUPPORTING RESEARCH - FISCAL YEAR 1974

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0007 MORPHOLOGY OF TWO TORNADIC STORMS - AN ANALYSIS OF NSSI DATA ON APRIL 30, 1970 - OKLAHOMA CITY, OKLAHOMA

S.L. BARNES, U.S. Dept. of Commerce, Natl. Severe Storms Lab.

12.0008 TORNADO INCIDENCE MAPS

A. COURT, U.S. Dept. of Commerce, Natl. Severe Storms Lab.

12.0009 TORNADOES IN TENNESSEE (1916-1970) WITH REFERENCE TO NOTABLE TORNADO DISASTER IN THE UNITED STATES (1880-1970)

J.Y. VAIKSNORAS, U.S. Dept. of Commerce, Natl. Weather Service

12.0010 ARIZONA 'EDDY' TORNADOES

R.S. INGRAM, U.S. Dept. of Commerce, Natl. Weather Service

12.0012 NATIONAL SEVERE LOCAL STORMS OPERATIONS PLAN

R.E. HALLOREN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0013 NATIONAL EAST COAST WINTER STORMS - OPERATIONS PLAN

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0014 NATIONAL SEVERE LOCAL STORMS OPERATIONS PLAN - 1974

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0015 MISSISSIPPI DELTA TORNADOES OF FEBRUARY 21, 1971 - A REPORT TO THE ADMINISTRATOR

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0016 WATER WARNINGS AND SPECIALIZED FORECASTS

UNKNOWN, U.S. Air Force, Air Weather Service

12.0020 SUMMARY OF 1969 AND 1970 PUBLIC SEVERE THUNDERSTORM AND TORNADO WATCHES WITHIN THE NATIONAL WEATHER SERVICE, EASTERN REGION

M.E. MILLER, U.S. Dept. of Commerce, Weather Bureau

12.0021 TORNADOES

E. KESSLER, U.S. Dept. of Commerce, Natl. Severe Storms Lab.

12.0022 OBSERVATIONS OF SEVERE STORMS ON 26 AND 28 APRIL 1971

C.L. VLECK, U.S. Dept. of Commerce, Natl. Severe Storms Lab.

12.0023 SEVERE STORM MORPHOLOGY - OKLAHOMA

S.L. BARNES, U.S. Dept. of Commerce, Environ. Research Laboratories

12.0024 PAPERS ON OKLAHOMA THUNDERSTORMS, APRIL 29-30, 1970

12.0025 LIFE CYCLE OF FLORIDA KEYS SPOUTS

J.H. GOLDEN, U.S. Dept. of Commerce, Environ. Laboratories

12.0026 DOPPLER RADAR METHODOLOGY - OBSERVATION OF CONVECTIVE STORMS

R.M. LHERMITTE, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0027 EM RADIATION-TORNADOES

W. TAYLOR, U.S. Dept. of Commerce, Environ. Laboratories

12.0028 HURRICANE SPAWNED TORNADOES

D.J. NOVLAN, Colorado State University, School of Engineering

12.0030 ESTIMATE OF MAXIMUM WIND SPEEDS IN TORNADOES IN THREE NORTHWESTERN IDAHO, OREGON, WASHINGTON

T.T. FUJITA, Univ. of Chicago, School of Physics

12.0031 PROPOSED CHARACTERIZATION OF TORNADOES AND HURRICANES BY AREA AND INTENSITY

T.T. FUJITA, Univ. of Chicago, School of Physics

12.0036 DUST DEVIL METEOROLOGY

J.R. COOLEY, U.S. Dept. of Commerce, Natl. Weather Service

12.0037 DAILY TORNADO FREQUENCIES IN CONTIGUOUS UNITED STATES

H. GORDON, U.S. Dept. of Commerce, Natl. Weather Service

12.0039 SOME STATISTICAL ASPECTS OF SPOUT FORMATION - FLORIDA

J.H. GOLDEN, U.S. Dept. of Commerce, Natl. Severe Storms Lab.

12.0041 COMPUTER SIMULATION OF SEVERE STORM OBSERVATIONS WITH DOPPLER RADAR

UNKNOWN, Tetra Tech Incorporated

U.S. DEPT. OF DEFENSE - AIR FORCE

12.0003 THE OCHILTREE TORNADO - A CASE STUDY - MISSOURI

W.E. FINLEY, U.S. Air Force, Environ. Tech.

12.0029 FORECASTING GUSTY SURFACE WINDS - THE CONTINENTAL UNITED STATES

A.W. WATERS, U.S. Air Force, Air Weather Service

U.S. DEPT. OF DEFENSE - ARMY

12.0040 IMPACT OF THE DUBBOCK STORM ON REGIONAL SYSTEMS - TEXAS

J.E. MINOR, Texas Technological University, School of Engineering

U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

12.0006 XENIA REBUILDS

UNKNOWN, Xenia Commission

12.0011 URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology

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12.0018 WIND-INDUCED MOTION AND HUMAN DISCOMFORT IN TALL BUILDINGS

J.W. REED, Mass. Inst. of Technology, School of Engineering

12.0019 NUMERICAL ANALYSIS OF TORNADO WIND LOADS ON BUILDINGS - TEXAS

R.A. GENTRY, U.S. Atomic Energy Commission, Los Alamos Scientific Lab.

12.0032 STUDY OF URBAN EFFECTS ON PRECIPITATION AND SEVERE WEATHER AT ST. LOUIS - ILLINOIS

S.A. CHANGNON, State Water Survey

UNIVERSITY OF ILLINOIS

12.0035 PROBABILISTIC MODELING OF EXTREME LOADS

Y.K. IVEN, Univ. of Illinois, School of Engineering

TSUNAMIS

U.S. DEPT. OF COMMERCE - N.O.A.A.

13.0004 TSUNAMI RESEARCH

S.T. ALGERMISSEN, U.S. Dept. of Commerce, Environ. Research Laboratories

13.0005 TSUNAMI RESEARCH

G.R. MILLER, U.S. Dept. of Commerce, Environ. Research Laboratories

13.0007 WAVE REPORTING PROCEDURES FOR TIDE OBSERVERS IN THE TSUNAMI WARNING SYSTEM

M.G. SPAETH, U.S. Dept. of Commerce, Natl. Ocean Survey

13.0008 TSUNAMI TRAVEL-TIME CHARTS FOR USE IN THE TSUNAMI WARNING SYSTEM REVISED 1971 EDITION

UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey

13.0020 NUMERICAL SIMULATION OF TSUNAMIS

C.L. MADER, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

13.0022 RELATIVE SPECTRA OF TSUNAMIS

G.R. MILLER, Univ. of Hawaii, Hawaii Inst. of Geophysics

13.0023 RECENT TSUNAMI THEORY

R.W. PREISENDORFER, Univ. of Hawaii, Hawaii Inst. of Geophysics

13.0024 TSUNAMI SHORELINE TRACT

G.P. WOOLLARD, Univ. of Hawaii, Hawaii Inst. of Geophysics

U.S. DEPT. OF DEFENSE - ARMY

13.0001 FREQUENCIES OF CREST HEIGHTS FOR RANDOM COMBINATIONS OF ASTRONOMICAL TIDES AND TSUNAMIS RECORDED AT CRESCENT CITY, CALIFORNIA

C. PETRAUSKAS, Univ. of California, School of Engineering

13.0009 STABILITY OF RIBBLE-MOUND TSUNAMI BARRIER HILO HARBOR, HAWAII. HYDRAULIC MODEL INVESTIGATION

A.M. KAMEL, U.S. Army, Waterways Experiment Station

13.0010 STEADY-FLOW STABILITY TESTS OF NAVIGATION OPENING STRUCTURES, HILO HARBOR, TSUNAMI BARRIER, HILO, HAWAII - HYDRAULIC MODEL INVESTIGATION

N.R. OSWALT, U.S. Army, Waterways Experiment Station

13.0019 LONG-PERIOD WAVES AND SURGES

UNKNOWN, U.S. Army, Coastal Engin. Res. Center

13.0026 THEORETICS IN DESIGN OF THE PROPOSED CRESCENT CITY HARBOR TSUNAMI MODEL

G.H. KEULEGAN, U.S. Army, Waterways Experiment Station

13.0027 A REVIEW OF THE EXPERIMENTAL DATA RELATIVE TO THE PILOT MODEL STUDY FOR THE DESIGN OF HILO HARBOR TSUNAMI MODEL

G.H. KEULEGAN, U.S. Army, Waterways Experiment Station

13.0028 TSUNAMI PREDICTIONS FOR PACIFIC COASTAL COMMUNITIES - TYPE 16 FLOOD INSURANCE STUDY

R.W. WHALIN, U.S. Army, Waterways Experiment Station

13.0029 THE PROPAGATION OF LARGE AMPLITUDE TSUNAMIS ACROSS A BASIN OF CHANGING DEPTH - OFF-SHORE BEHAVIOR

E. VARLEY, Lehigh University, Ctr. for the Appl. of Math.

U.S. DEPT. OF DEFENSE - NAVY

13.0002 GENERAL REVIEW OF THE SEISMIC HAZARD TO SELECTED U.S. NAVY INSTALLATIONS

J.B. SEED, Calif. Inst. of Technology, Graduate School

13.0016 NAVY ENVIRONMENT - INVESTIGATIONS OF GENERATION OF OCEAN WAVES AND OF RESONANT RESPONSE OF HARBORS TO TSUNAMIS AND OTHER LONG WAVES

J.W. MILES, Univ. of California, Inst. of Geophys. & Plan. Phys.

U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

13.0003 URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)

J.T. ALFORE, State Div. of Mines & Geology

U.S. DEPT. OF INTERIOR - GEOLOGICAL SURVEY

13.0011 TSUNAMI SYSTEMS ENGINEERING - NEW

TsunamiS

- G. PLAFKER*, U.S. Dept. of the Interior, Geological Survey
- 13.0014 ACTIVE FAULTS AND GEOLOGIC HAZARDS.
PT. MUGU TO WILMINGTON, CALIFORNIA
H.C. WAGNER, U.S. Dept. of the Interior, Geological Survey
- 13.0017 ENGINEERING GEOLOGY RECONNAISSANCE
STUDIES OF COASTAL COMMUNITIES, ALASKA
R.W. LEMKE, U.S. Dept. of the Interior, Geological Survey
- 13.0018 RECONNAISSANCE ENGINEERING GEOLOGY
OF THE SITKA AREA, ALASKA
J.T. MCGILL, U.S. Dept. of the Interior, Geological Survey

U.S. DEPT. OF INTERIOR - O.W.R.T.

- 13.0006 TRANS-ALASKA PIPELINE - SUPPLEMENTAL
EXHIBITS AND TESTIMONY - VOLUME V
UNKNOWN, U.S. Dept. of the Interior

U.S. NATL. SCIENCE FOUNDATION

- 13.0012 EVALUATION OF LONG PERIOD SURFACE
WAVES IN THE GULF OF ALASKA
T.C. ROYER, Univ. of Alaska, Inst. of Marine Sciences
- 13.0015 TSUNAMI RESEARCH AND ENGINEERING AP-
PLICATIONS
L. HIRANG, Tetra Tech Incorporated
- 13.0021 PACIFIC TSUNAMI CATALOG
D.C. COX, Univ. of Hawaii, School of Arts

VOLCANOES

U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

- 14.0001 VOLCANIC HAZARDS ON THE ISLANDS OF
HAWAII
D.R. MULLINEAUX, U.S. Dept. of the Interior, Geological Survey
- 14.0003 URBAN GEOLOGY PLAN FOR CALIFORNIA -
THE NATURE, MAGNITUDE, & COSTS OF GEOLOG-
IC HAZARDS & RECOMMENDATIONS FOR THEIR
MITIGATION (ABBREV)
J.T. ALFORD, State Div. of Mines & Geology

U.S. DEPT. OF INTERIOR - GEOLOGICAL SURVEY

- 14.0002 SATELLITE VOLCANO SURVEILLANCE -
ALASKA, HAWAII AND WASHINGTON
P.L. WARD, U.S. Dept. of the Interior, Geological Survey
- 14.0004 HAWAIIAN VOLCANO OBSERVATORY
D.W. PETERSON, U.S. Dept. of the Interior, Geological Survey
- 14.0006 GEODIMETER STUDIES OF CASCADE VOL-
CANOES - WASHINGTON, OREGON AND CALIFOR-
NIA
D.A. SWANSON, U.S. Dept. of the Interior, Geological Sur-

SUPPORTING

- 14.0008 THERMAL SURVEILLANCE OF
REMOTE SENSING OF LONG VALLEY
MAI, PROGRAM - WASHINGTON,
CALIFORNIA
J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey
- 14.0010 VOLCANIC HAZARDS, ISLAND
D.R. MULLINEAUX, U.S. Dept. of the Interior, Geological Survey
- 14.0011 EASTERN SNAKE RIVER PLAIN VOLCANIC
VESTIGATIONS - IDAHO
S.S. ORIEL, U.S. Dept. of the Interior, Geological Survey
- 14.0012 SNAKE RIVER PLAIN, PART I
TRAIL - IDAHO
D. SCHLEICHER, U.S. Dept. of the Interior, Geological Survey
- 14.0013 SNAKE RIVER PLAIN, PART II
ROCKS - IDAHO
P.L. WILLIAMS, U.S. Dept. of the Interior, Geological Survey
- 14.0014 REGIONAL VOLCANOLOGY
UNITED STATES INCLUDING ALASKA
R.L. SMITH, U.S. Dept. of the Interior, Geological Survey

U.S. DEPT. OF INTERIOR - O.W.R.T.

- 14.0015 RAINWATER CONTAMINATION
VOLATILES FROM KILAUEA VOLCANO
(PHASE I)
J.B. FINLAYSON, Univ. of Hawaii, School of Earth & Atmospheric Sciences, Research Ctr.

U.S. NATL. AERO. & SPACE ADMINISTRATION

- 14.0009 THERMAL SURVEILLANCE OF
VOLCANOES
J.D. FRIEDMAN, U.S. Dept. of the Interior, Geological Survey

U.S. NATL. SCIENCE FOUNDATION

- 14.0005 SEISMIC SURVEILLANCE OF
DOUBT AND SPURR VOLCANOES
ALASKA
J. KIENLE, Univ. of Alaska, Geophysical Institute
- 14.0016 SEISMIC ACTIVITY OF THE
VOLCANOES
S.W. SMITH, Univ. of Washington, School of Earth & Atmospheric Sciences

WATER EROSION

FLORIDA STATE GOVERNMENT - TECHNICAL SERVICES DIVISION

- 15.0016 COASTAL ENGINEERING STUDIES
TO FLORIDA'S SHORELINE AND EROSION
PROBLEMS
J.A. BURDICK, Univ. of Florida, School of Civil Engineering

NEW YORK OCEAN SCI. LAB. - MONTAUK, N.Y.

- 15.0028 GROIN STUDY ON THE NORTH SHORE OF
SUFFOLK COUNTY, LONG ISLAND, NEW YORK,
BETWEEN ORIENT POINT AND PORT JEFFERSON
HARBOR
T. OMHOLT, New York Ocean Science Lab

OHIO STATE GOVERNMENT - COLUMBUS

- 15.0030 SHORE EROSION STUDY OF ERIE COUNTY,
OHIO
L.L. BRAIDECH, State Div. of Geolog. Survey
- 15.0031 SHORE EROSION STUDY OF LAKE COUNTY,
OHIO
L.L. BRAIDECH, State Div. of Geolog. Survey
- 15.0032 SHORE EROSION STUDIES ALONG THE OHIO
SHORE OF LAKE ERIE
C.H. CARTER, State Div. of Geolog. Survey

U.S. DEPT. OF AGRICULTURE

- 15.0034 EROSION AND SEDIMENTATION FOLLOWING
ROAD CONSTRUCTION AND TIMBER HARVEST ON
UNSTABLE SOILS IN THREE SMALL WESTERN
OREGON WATERSHEDS
R.L. FREDRIKSEN, U.S. Dept. of Agriculture, Pac. N.W.
For. & Rg. Exp. Sta.

U.S. DEPT. OF AGRICULTURE - F.S.

- 15.0002 FLOOD AND SEDIMENT REDUCTION IN STEEP
UNSTABLE BRUSSLANDS OF THE SOUTHWEST
R.M. RICE, U.S. Dept. of Agriculture, Pac. S.W. For. &
Rg. Exp. Sta.

U.S. DEPT. OF COMMERCE - N.O.A.A.

- 15.0001 COMPOSITE MATERIALS FOR OCEAN CON-
STRUCTION
A.S. TETELMAN, Univ. of California, School of Engineering
- 15.0017 A STUDY OF NEARSHORE PROCESSES IN
SOUTHEAST FLORIDA
C. EMILIANI, Univ. of Miami, School of Marine Science
- 15.0026 COASTAL ZONE AND SHORELANDS MANAGE-
MENT - GREAT LAKES
J.M. ARMSTRONG, Univ. of Michigan, School of Engineer-
ing
- 15.0027 ENVIRONMENTAL GEOMORPHIC STUDY OF
THE COASTAL REGIMES ALONG THE SOUTH
SHORE OF LONG ISLAND - NEW YORK
D.R. COATES, State University of New York, School of
Arts
- 15.0029 EROSION AND DEPOSITION IN THE SOUNDS
AND ESTUARIES OF THE NORTH CAROLINA
COAST
R.L. INGRAM, Univ. of North Carolina, School of Arts

U.S. DEPT. OF DEFENSE - ARMY

- 15.0004 CONCRETE BLOCK REVELMENT
BENEDICT, MARYLAND
J.V. HALL, U.S. Army, Coastal Engin. Res. Cent.
- 15.0006 BAI. HARBOUR, FLORIDA PARTIAL
RESTORATION, BEACH EROSION CONTROL
HURRICANE PROTECTION PROJECT, DALLAS
COUNTY, FLORIDA
UNKNOWN, U.S. Army, Engineer District
- 15.0007 JEKYL. ISLAND, GEORGIA, BEACH
CONTROL AND HURRICANE PROTECTION
UNKNOWN, U.S. Army, Engineer District
- 15.0009 STATEN ISLAND BEACH EROSION
AND HURRICANE PROTECTION PROJECT
ISLAND, NEW YORK
UNKNOWN, U.S. Army, Engineer District
- 15.0010 BEACH EROSION PROJECT, DELAWARE
COAST PROTECTION PROJECT, DELAWARE
UNKNOWN, U.S. Army, Engineer District
- 15.0011 VIRGINIA BEACH, VIRGINIA - BEACH
SION CONTROL AND HURRICANE PROTECTION
UNKNOWN, U.S. Army, Engineer District
- 15.0015 COASTAL WORKS EVALUATION -
FLORIDA
UNKNOWN, U.S. Army, Coastal Engin. Res. Cent.
- 15.0019 NATIONAL SHORELINE STUDY -
LAKES REGION INVENTORY REPORT
UNKNOWN, U.S. Army, North Central Division
- 15.0021 NATIONAL SHORELINE STUDY - IN-
VENTORY REPORT - LOWER MISSISSIPPI REGION
UNKNOWN, U.S. Army, Engineer District

U.S. DEPT. OF DEFENSE - NAVY

- 15.0014 SHORT-TERM CLIMATE CHANGE
COASTAL EROSION, BARROW, ALASKA
J.D. HUME, Arctic Inst. of North America
- 15.0022 OFF-SET COASTAL INLETS - FORMS
MENT ACCUMULATION IN THE BEACH
ALASKA, NEW ENGLAND
M.O. HAYES, Univ. of Massachusetts, Coastal
Center
- 15.0024 SIMULATION MODEL FOR STORM
AND BEACH EROSION ON LAKE MICHIGAN
R.A. DAVIS, Williams College, Graduate School
- 15.0025 PROFILE OF A STORM - WIND, WAVE
EROSION ON THE SOUTHEASTERN SHORE OF
LAKE MICHIGAN
W.T. FOX, Williams College, Graduate School

U.S. DEPT. OF HOUSING & URBAN DEVELOPMENT

- 15.0001 URBAN GEOLOGY PLAN FOR CALIFORNIA

WATER EROSION

U.S. DEPT. OF INTERIOR - GEOLOGICAL SURVEY

15.0013 SAN FRANCISCO BAY

D. McULLOCH, U.S. Dept. of the Interior, Geological Survey

15.0023 SEA-CLIFF EROSION STUDIES, MASSACHUSETTS

C.A. KAYE, U.S. Dept. of the Interior, Geological Survey

15.0037 TEXAS BARRIER ISLANDS

R.E. HUNTER, U.S. Dept. of the Interior, Geological Survey

15.0039 SEDIMENT MOVEMENT AND HILLSLOPE MORPHOLOGY IN THE CENTRAL APPALACHIAN REGION - VIRGINIA

UNKNOWN, U.S. Dept. of the Interior, Geological Survey

U.S. DEPT. OF INTERIOR - O. WTR. RES. RCIL

15.0018 DEPOSITION OF HAWAIIAN WATERSHED AND ESTUARINE SEDIMENTS

P. FAN, Univ. of Hawaii, Water Resources Research Ctr.

15.0033 EVALUATION OF GEOLOGIC AND OCEANOGRAPHIC FACTORS INFLUENCING EROSION OF THE OREGON COAST

J.P. BYRNE, Oregon State University, School of Science

15.0038 ENVIRONMENTAL GEOLOGY OF SELECTED PARTS OF NORTHWESTERN VERMONT

W.P. WAGNER, Univ. of Vermont, State Resources Res. Center

U.S. DEPT. OF INTERIOR - O.W.R.T.

15.0008 PLANT SPECIES AS WILDLIFE COVER AND EROSION CONTROL ON 'MUDFLATS' IN IOWA'S LARGE RESERVOIR SYSTEMS

J.A. WILSON, Iowa State University, Water Resources Research Inst.

U.S. NATL. AERO. & SPACE ADM.

15.0005 KENNEDY SPACE CENTER OCEAN BEACH EROSION - FLORIDA

A.J. MEHTA, Univ. of Florida, School of Engineering

U.S. NATL. SCIENCE FOUNDATION

15.0012 HYDRAULIC EROSION OF SOILS

K. ARULANANDAN, Univ. of California, School of Engineering

15.0035 PROPERTIES AND STABILITY OF A TEXAS BARRIER BEACH INLET

C. MASON, Texas A & M University System, Graduate School

MULTIPLE HAZARDS

NATL. ACADEMY OF SCIENCES - WASHINGTON

16.0064 FIELD STUDIES OF DISASTER BEHAVIOR INVENTORY

UNKNOWN, Natl. Acad. of Sciences

16.0065 TOWARD REDUCTION OF LOSSES FROM EARTHQUAKES

UNKNOWN, Natl. Acad. of Sciences

NO FORMAL SUPPORT REPORTED

16.0001 EMERGENCY OPERATIONS DEVELOPMENT - CIVIL DEFENSE RESCUE

L.C. THOMAS, Stanford Research Institute

16.0004 PROBING THE LAW AND BEYOND - FOR PUBLIC PROTECTION FROM HAZARDOUS PRODUCT CATASTROPHES

J.M. BROWN, George Washington University, Pr. Stud. Sci. Tech.

16.0017 THE SALVATION ARMY - ITS STRUCTURE, OPERATIONS, AND PROBLEMS IN DISASTER RELIEF

J.L. ROSS, Ohio State University, Disaster Research Center

16.0019 RECOVERY FROM NATURAL DISASTERS - SURVIVAL OR FEDERAL AID

UNKNOWN, Univ. of Pennsylvania, School of Civil Engineering

16.0036 PLAN FOR AN IMPROVED COMMUNICATION SYSTEM SERVING THE EMERGENCY SERVICES DEPARTMENTS OF THE CITY OF LOS ANGELES (BREV)

UNKNOWN, Hughes Aircraft Company

16.0039 IMPROVED OUTDOOR ALERTING AND COMMUNICATIONS

R.L. LAMOUREUX, System Development Corporation

16.0040 REGULATION OF GREAT LAKES LEVELS - A SUMMARY REPORT/1974

UNKNOWN, Internat. Joint Commission

16.0041 REGULATION OF GREAT LAKES LEVELS REPORT TO THE INTERNATIONAL COMMISSION BY THE INTERNATIONAL LAKES LEVELS BOARD

UNKNOWN, Internat. Joint Commission

16.0076 NATIONAL ATMOSPHERIC SCIENCE PROGRAM - FISCAL YEAR 1974

UNKNOWN, U.S. Exec. Office of the Pres., Off. of Science & Technology

16.0097 THE POLICE DEPARTMENT IN NATURAL DISASTER OPERATIONS

J.M. BROOKS, Ohio State University, Disaster Research Center

16.0099 THE WARNING SYSTEM IN DISASTERS - A SELECTIVE ANALYSIS

R.F. MCLUCKIE, Ohio State University, Disaster Research Center

16.0104 ENVIRONMENTAL GEOLOGIC ATLAS OF THE TEXAS COASTAL ZONE, GALVESTON-HOUSTON AREA

W.L. FISHER, Univ. of Texas, Bureau of Economic Geology

OHIO STATE GOVERNMENT - COLUMBUS

16.0016 ANALYSIS OF EMERGENCY MEDICAL SERVICES COLUMBUS AND ALL FRANKLIN COUNTY POLITICAL SUBDIVISIONS

R.C. CHASE, Ohio State University, School of Medicine

R. W. JOHNSON FOUND. - NEW BRUNSWICK, N.J.

16.0029 A NATIONWIDE PROGRAM TO DEVELOP REGIONAL EMERGENCY MEDICAL COMMUNICATIONS SYSTEMS

D. MCCONNAUGHEY, Natl. Acad. of Sciences

TEXAS A. & M. UNIVERSITY SYSTEM

16.0024 THE ROLE OF HELICOPTERS IN EMERGENCY MEDICAL CARE SYSTEMS

D.P. SKOGMAN, Texas A & M University System, School of Engineering

U.S. DEPT. OF AGRICULTURE - C.S.R.S.

16.0021 MANAGEMENT OF INSURABLE RISK

M.B. BADENHOP, Univ. of Tennessee, Agricultural Experiment Sta.

U.S. DEPT. OF COMMERCE - E.S.S.A.

16.0043 ESSA AND OPERATION FORESIGHT

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

U.S. DEPT. OF COMMERCE - N.B.S.

16.0030 NATURAL DISASTERS - SOME EMPIRICAL AND ECONOMIC CONSIDERATIONS

G.T. SAV, U.S. Dept. of Commerce, Natl. Bureau of Standards

16.0073 BUILDING PRACTICES FOR DISASTER MITIGATION

R.N. WRIGHT, U.S. Dept. of Commerce, Natl. Bureau of Standards

U.S. DEPT. OF COMMERCE - N.O.A.A.

16.0045 SUMMARY REPORT - WEATHER MODIFICATION - FISCAL YEARS 1969, 1970, 1971

R.C. KOCH, Geomet Incorporated

16.0046 FEDERAL PLAN FOR WEATHER RADARS

UNKNOWN, U.S. Dept. of Commerce, National Weather Service

16.0066 WEATHER & CLIMATE MODIFICATION PROBLEMS AND PROGRESS

UNKNOWN, Natl. Acad. of Sciences

16.0067 WEATHER SATELLITE CAPABILITIES - PRESENT AND FUTURE

R.L. PYLE, U.S. Dept. of Commerce, Natl. Environ. Sate-

16.0069 FEDERAL PLAN FOR METEOROLOGICAL SERVICES & SUPPORTING RESEARCH - FISCAL YEAR 1973

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

16.0070 FEDERAL PLAN FOR METEOROLOGICAL SERVICES & SUPPORTING RESEARCH - FISCAL YEAR 1975

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

16.0071 A FEDERAL PLAN FOR NATURAL DISASTER WARNING AND PREPAREDNESS

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

16.0072 PLAN TO IMPROVE LOCAL WEATHER FORECASTS

UNKNOWN, U.S. Dept. of Commerce, Off. of Plans & Programs

16.0090 WEATHER MODIFICATION - FISCAL YEARS 1969, 1970, 1971

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

16.0091 CLIMATES OF THE STATES - CLIMATE OF NEW YORK

A.B. PACK, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

16.0092 OPERATIONS OF THE NATIONAL WEATHER SERVICE

UNKNOWN, U.S. Dept. of Commerce, National Weather Service

U.S. DEPT. OF DEFENSE - ARMY

16.0007 MILITARY BLOOD BANKING (CIVIL DISASTERS)

F.R. CAMP, U.S. Army, Medical Research Laboratory

16.0008 BODY RECOVERY DOG

W.L. QUINN, U.S. Army, Land Warfare Laboratory

16.0026 DEBRIS CLEARING TIMES AFFECTING CRITICAL SURVIVAL ACTIONS

T.N. WILLIAMSON, Jacobs Associates

16.0027 IMPROVISING ELECTRIC POWER FROM INDUCTION GENERATORS DURING PROLONGED POWER OUTAGES

R.H. BLACK, U R S Systems Corporation

16.0033 COMMUNICATIONS IN NATURAL DISASTERS

R.A. STALLINGS, Ohio State University, Disaster Research Center

16.0037 OPTIMUM UTILIZATION OF GOVERNMENT AND NON-GOVERNMENT COMMUNICATIONS RESOURCES

A.W. WIEGANT, Stanford Research Institute

16.0044 MINIMIZING DAMAGE TO REFINERIES FROM NUCLEAR ATTACK, NATURAL AND OTHER DISASTERS

M.M. STEPHENS, U.S. Dept. of the Interior, Office of Oil

- 16.0053 NATURAL DISASTER OPERATIONS PLANNING
C.T. RAINEY, Stanford Research Institute
- 16.0057 ON ESTIMATION OF MAXIMUM WIND SPEEDS
IN TORNADOES AND HURRICANES
P. DERGARABEDIAN, T R W Incorporated
- 16.0059 EMERGENCY OPERATIONS CONTINGENCY
PLANNING - NEW ORLEANS, LOUISIANA
A.I. ABERSMAN, System Development Corporation
- 16.0060 DEVELOPMENT OF IMPROVED EMERGENCY
OPERATIONS SIMULATION TRAINING (EOST)
TRAINING PROCEDURES
R.C. HARKER, System Development Corporation
- 16.0078 LABORATORY STUDIES OF THE EFFECTS OF
PHYSICAL HAZARD ON SHELTER MANAGEMENT
BEHAVIOR - PHASE I - STUDY PLAN
T.R. ARMSTRONG, Amer. Inst. For Res.
- 16.0079 THE INVESTIGATION OF SHELTER MANAGE-
MENT AND CONTROL IN NATURAL DISASTER
R.A. COLLINS, Amer. Inst. For Res.
- 16.0085 AN ANALYSIS OF OPERATING SYSTEM EF-
FECTIVENESS - FOCUS ON THE BEHAVIOR OF
LOCAL COORDINATORS
C.T. GRIFFIN, Iowa State University, School of Science
- 16.0086 ROLE PERFORMANCE IN THE OPERATING
SYSTEM - CIVIL DEFENSE OPERATIONS IN DIS-
ASTER
C.L. MULFORD, Iowa State University, School of Science
- 16.0087 SECURING COMMUNITY RESOURCES FOR SO-
CIAL ACTION
C.L. MULFORD, Iowa State University, School of Science
- 16.0098 A PERSPECTIVE ON DISASTER PLANNING
R.R. DYNES, Ohio State University, Disaster Research
Center
- 16.0101 DISASTER RELIEF - DOMESTIC ACTION IN
THE SPOTLIGHT
E.J. RUSH, U.S. Army, War College
- 16.0107 EXPEDIENT AM AND FM BROADCAST AN-
TENNAS
D.E. PAULEY, Gantney & Jones Comm. Inc.
- 16.0108 AREA-WIDE DISASTER RESPONSE - CIVIL
PREPAREDNESS AND REGIONAL COUNCILS
R.J. MARSHAK, Human Sciences Research Inc.

U.S. DEPT. OF DEFENSE - D.S.A.

- 16.0106 SOIL POLLUTION - EROSION EFFECTS IN SOIL
UNKNOWN, U.S. Dept. of Defense, Defense Documenta-
tion Center

U.S. DEPT. OF DEFENSE - NAVY

- 16.0010 SEARCH AND RESCUE COMMUNICATION--
GLOBAL RESCUE ALARM NET (GRAN)
W.R. CRAWFORD, U.S. Navy, Air Test Center

U.S. DEPT. OF HLTH. ED. & WEL.

- 16.0002 CONSULTATIVE PSYCHIATRIC
INDIVIDUALS AND COMMUNITY
AGENCIES IN RAPID CITY, SOUTH D.
C.L. KEENER, Unknown Inst. or Indiv. Grant
- 16.0006 A SIMULATION MODEL FOR
MEDICAL SYSTEMS
H.E. SMALLLEY, Georgia Inst. of Tech.
Systems Research Center
- 16.0011 PUBLIC HEALTH SERVICE
ASSISTANCE REPORT JULY 1967-JUN
UNKNOWN, U.S. Dept. of Hlth. Ed. & W.
Serv. & M.H. Adm.
- 16.0018 SYSTEMS ANALYSIS OF EMER-
GENT DELIVERY
W.F. HAMILTON, Univ. of Pennsylvania
Medicine
- 16.0100 ORGANIZATIONAL RESPONSES
COMMUNITY CRISES
E.L. QUARANTELLI, Ohio State University
Social Science

U.S. DEPT. OF HOUSING & URBAN DEV.

- 16.0005 THE FEDERAL RESPONSE TO
STORM AGNES: A REPORT TO THE
COMMITTEE ON PUBLIC WORKS, SUBCOM-
MITTEE ON DISASTER RELIEF
UNKNOWN, U.S. Exec. Office of the Pres.
Emergency Preparedness
- 16.0023 DESIGN TO ESTABLISH A FEEDBACK
FOR EMERGENCY MEDICAL CARE
METROPOLITAN NASHVILLE-MIDDLE
REGION
C.E. GOSHEN, Urban Obs. of Met. Nashville
- 16.0025 URBAN GEOLOGY - PLAN FOR
THE NATURE, MAGNITUDE, AND
GEOLOGIC HAZARDS AND RECOM-
MENDATIONS FOR THEIR MITIGATION (ABBREV)
UNKNOWN, State Div. of Mines & Geology
- 16.0038 URBAN GEOLOGY PLAN FOR
THE NATURE, MAGNITUDE, & COSTS OF
GEOLOGIC HAZARDS & RECOMMENDATIONS
FOR THEIR MITIGATION (ABBREV)
J.T. ALFORD, State Div. of Mines & Geology
- 16.0050 PUBLIC SAFETY SUBSYSTEM
ANALYSIS OVERVIEW
UNKNOWN, Unknown Inst. or Indiv. Grant
- 16.0051 PUBLIC SAFETY SUBSYSTEM
REALIZATION TASK COMPLETION REPORT
UNKNOWN, Unknown Inst. or Indiv. Grant
- 16.0058 THE SEISMIC SAFETY STUDY
GENERAL PLAN
D. ARMSTRONG, Tri Cities Seismic Safe. S.

16.0080 SARASOTA - ZONING AND SUBDIVISION CONTROLS REVIEW, ANALYSIS, AND RECOMMENDATIONS CONCERNING CURRENT REGULATIONS
E.R. BARTLEY, Tampa Bay Regional Plan. Comm.

16.0081 A COMPREHENSIVE PLAN FOR STEPHENSON COUNTY, ILLINOIS
UNKNOWN, Stephenson Co. Planning Comm.

16.0083 ZONING ORDINANCE - KNOX COUNTY, INDIANA
UNKNOWN, Clyde E. Williams & Assoc. Inc.

16.0088 ZONING ORDINANCE AND ORDER, PIKE COUNTY, ELKHORN CITY, KENTUCKY
UNKNOWN, State Program Dev. Office

16.0089 ZONING ORDINANCE - PAINTSVILLE, KENTUCKY
UNKNOWN, State Program Dev. Office

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ALABAMA.

AURORA PLANNING BOARD

6.0332 COMPREHENSIVE PLAN - REPORT
ON DEVELOPMENT - VILLAGE OF EAST AURORA,
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BOISE STATE COLLEGE
SCHOOL OF ARTS

6.0003 SILVER VALLEY FLOOD - SOCIAL AND
ECONOMIC EFFECTS.

BULLITT CO. PLANNING COMM.

6.0286 FLOOD PLAN FOR BULLITT COUNTY,
KENTUCKY.

CENTRAL NEW YORK REG. PLAN.

6.0133 WATER RELATED ENVIRONMENTAL

CLATSOP TILLAMOOK INTERGOV.

6.0352 FLOOD PLAIN ANALYSIS AND DIS-
SEMINATION, CLATSOP AND TILLAMOOK COUNTIES,
1972-1973.

CLYDE E. WILLIAMS & ASSOC. INC.

6.0268 ZONING ORDINANCE - KNOX COUNTY,
TENNESSEE.

COLORADO STATE UNIVERSITY
SCHOOL OF ENGINEERING

6.0050 FLOOD PROTECTION AT CULVERT

6.0189 INVESTIGATION FOR FLOOD PRO-
TECTION OF BRIDGES.

6.0190 HYDROLOGY OF SMALL WATERSHEDS

CORNELL UNIVERSITY
WATER RESOU. & MARINE SC. CTR.

- 6.0334 REDESIGNING FLOOD MANAGEMENT - PROJECT AGNES - PHASE I.

D.J. ALLEE

- 6.0335 STUDIES IN THE ANALYSIS OF METROPOLITAN WATER RESOURCE SYSTEMS - VOLUME IV - MODELS FOR MANAGING METROPOLITAN SURFACE WATER SYSTEMS.

J.R. FERGUSSON

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- 6.0042 SAN GORGONIO PASS, CALIFORNIA GENERAL PLAN TECHNICAL REPORT.

UNKNOWN

- 6.0178 NORTH RICHMOND - SAN PABLO BAY AREA STUDY - CALIFORNIA.

J.P. KENNY

- 6.0179 GENERAL PLAN REPORT, LAKE RED BLUFF AREA, CALIFORNIA, 1971.

UNKNOWN

DIVERSIFIED CONSULTANTS INC.

- 6.0307 URBAN SYSTEMS - STORM DRAINAGE & FLOOD PLAIN MANAGEMENT, SANITARY SEWERAGE, SOLID WASTE MANAGEMENT (ABBREV).

J.A. ELLIOTT

- 6.0308 URBAN SYSTEMS - WATERWORKS, SANITARY SEWERAGE, SOLID WASTE MANAGEMENT, STORM DRAINAGE & FLOOD PLAIN MANAGEMENT (ABBREV).

J.A. ELLIOTT

EAST CENT. FLORIDA REG. COUN.

- 6.0072 ORANGE, SEMINOLE, OSCEOLA COUNTIES - WATER MANAGEMENT.

UNKNOWN

EASTERN PENN. PSYCH. INSTITUTE

- 6.0010 TRAINING AND EVALUATION OF MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN COMMONWEALTH OF PENNSYLVANIA.

UNKNOWN

ENVIRONMENTAL RES. INST. MICH.

- 6.0298 USE OF ERTS-1 DATA - SUMMARY REPORT OF WORK ON TEN TASKS.

F.J. THOMSON

FED. CITY COLLEGE
GRADUATE SCHOOL

- 6.0016 A STATISTICAL SUMMARY OF THE CAUSE AND COST OF BRIDGE FAILURES.

F.F. CHANG

GENESSEE FINGER LAKE REG. BOARD

GEORGIA INST. OF TECHNOLOGY
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- 6.0073 CASE STUDY OF REMEDIAL FLOOD MANAGEMENT IN AN URBAN AREA - PHASE I

- 6.0074 CRITICAL ANALYSIS OF FIVE FLOOD CONTROL MODELS IN FOUR PHYSIOGRAPHIC REGIONS OF GEORGIA.

- 6.0238 SYNTHESIZING A PROCEDURE FOR EVALUATING URBAN FLOOD CONTROL PLANS

- 6.0239 THE FLOOD PLAIN AS A RESIDENTIAL DEVELOPMENT - RESIDENT ATTITUDES AND PERCEPTIONS AND THEIR IMPLICATIONS TO FLOOD MANAGEMENT POLICY.

- 6.0240 THE PEACHTREE CREEK WATERSHED - CASE HISTORY IN URBAN FLOOD MANAGEMENT.

- 6.0241 TRAVEL TIME OF GEORGIA STATE HIGHWAYS

- 6.0242 THE EFFECTS OF LAND USE CHANGES ON THE HYDROLOGY OF AN URBAN WATERSHED

- 6.0243 A PROGRAM FOR METROPOLITAN WATER MANAGEMENT.

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- 6.0009 MENTAL HEALTH SERVICES TO RESIDENTS OF FLOOD DISASTER AREAS IN LUZERNE AND SHERBURN COUNTIES OF THE COMMONWEALTH OF PENNSYLVANIA.

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- 6.0177 PROCEDURES FOR ESTIMATING FLOOD DAMAGE FROM SMALL RURAL WATERSHEDS.

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- 6.0173 COMPUTER SIMULATION MODEL FOR FLOOD PLAIN DEVELOPMENT - PART II - MODEL DEVELOPMENT AND APPLICATIONS.

- 6.0174 COMPUTER SIMULATION MODEL FOR FLOOD PLAIN DEVELOPMENT - PART I - MODEL DEVELOPMENT AND BENEFIT EVALUATION.

- 6.0175 PLANNING FOR FLOOD DAMAGE REDUCTION

INST. FOR DEFENSE ANALYSIS

- 6.0032 NATURAL DISASTERS OPERATIONS PLANNING
FOR SLOWLY DEVELOPING DISASTERS, VOLUME 1,
A. SACHS

INTERNAT. JOINT COMMISSION

- 6.0052 REGULATION OF GREAT LAKES WATER
LEVELS REPORT TO THE INTERNATIONAL
JOINT COMMISSION BY THE INTERNATIONAL GREAT
LAKES LEVELS BOARD,
UNKNOWN

IOWA STATE UNIVERSITY
WATER RESOURCES RESEARCH INST.

- 6.0089 PLANT SPECIES AS WILDLIFE COVER AND
EROSION CONTROL ON 'MUDFLATS' IN IOWA'S
LARGE RESERVOIR SYSTEMS,
J.A. WILSON
6.0272 ECONOMIC FACTORS AFFECTING CHANGE IN
THE INTENSITY OF FLOOD PLAIN USE,
J.R. BARNARD
6.0273 THE HUMAN ECOLOGICAL IMPACT OF STRUC-
TURAL FLOOD CONTROL ON THE IOWA RIVER,
IOWA,
J.S. GARDNER

LINCOLN CO. PLANNING DEPT.

- 6.0354 DEVELOPMENT IN FLOOD-PRONE AREAS OF
LINCOLN COUNTY, OREGON AUGUST, 1973,
UNKNOWN

LOCKWOOD ANDREWS & NEWMAN INC.

- 6.0385 PALACIOS COMPREHENSIVE PLAN - PHASE 2 -
SUMMARY REPORT,
G.L. WILLIAMS

LOWER MINN. RIV. WTRSHED DIST.

- 6.0302 THE EFFECTIVENESS OF FLOOD CONTROL
STRUCTURE OF THE LOWER MINNESOTA RIVER
WATERSHED DISTRICT,
UNKNOWN

LUZERNE WYOMING CO. M.H. PROG.

- 6.0011 MENTAL HEALTH SERVICES TO RESIDENTS OF
FLOOD DISASTER AREAS IN LUZERNE-WYOMING
COUNTIES, COMMONWEALTH OF PENNSYLVANIA,
UNKNOWN

MACON CO. REGIONAL PLAN COMM.

- 6.0258 NATURAL CAPABILITIES - THE FRIENDS CREEK
SERIES, MACON COUNTY, ILLINOIS,
UNKNOWN

MASS. INST. OF TECHNOLOGY
SCHOOL OF ENGINEERING

- 6.0107 DESIGN OF OPTIMAL PRECIPITATION NET-
WORKS,

W.M. GRAYMAN

MATHEMATICA INCORPORATED

- 6.0101 THE IMPLICATIONS OF THE NET FISCAL
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CONTROL PROJECTS,

R.W. RAFUSE

MIDDLE GEORGIA AREA PLAN. COM.

- 6.0245 WATER RESOURCES OF MIDDLE GEORGIA,
UNKNOWN

MISSISSIPPI ST. UNIVERSITY
GRADUATE SCHOOL

- 6.0007 CASE STUDY OF ECONOMIC ASPECTS OF THE
FEDERAL FLOOD INSURANCE PROGRAM,
L.R. CHEATHAM

MONTANA STATE UNIVERSITY
SCHOOL OF ENGINEERING

- 6.0125 APPLICATION OF HYDROLOGIC AND HYDRAU-
LIC RESEARCH TO CULVERT SELECTION IN MON-
TANA - VOLUME 1 - REPORT,
E.R. DODGE

MONTANA STATE UNIVERSITY
WATER RESOURCES RESEARCH CTR.

- 6.0126 DEVELOPMENT OF AN OPERATIONS MODEL
FOR MONTANA'S WATER RESOURCES, MID-
DLE CREEK RESERVOIR OPERATION,
T.T. WILLIAMS
6.0321 FLOODPLAIN MAPPING AND PLANNING FOR
THE 50 AND 100 YEAR INTERVAL FLOOD ZONES OF
THE BITTERROOT VALLEY, MONTANA,
K.M. NOLAN

NORTH AMER. WEATHER CONSULT.

- 6.0171 CLOUD SEEDING POTENTIAL FOR TWELVE
RIVER BASINS,
R.D. ELLIOTT

NORTH KENNEBEC REG. PLAN. COMM.

- 6.0288 DATA AND MANAGEMENT NEEDS FOR WATER
RELATED LAND AREAS - MAINE,
E. KEENE

NORTHWESTERN UNIVERSITY
SCHOOL OF TECHNOLOGY

- 6.0259 RESEARCH INITIATION - A MULTIDIMENSIONAL STOCHASTIC MODEL FOR FLOOD PREDICTION,

R.B. COROTIS

OHIO STATE UNIVERSITY
SCHOOL OF ENGINEERING

- 6.0345 COST-EFFECTIVENESS ANALYSES OF REGIONAL FLOOD PLAIN MANAGEMENT ACTIVITIES,

G.M. CLARK

- 6.0346 APPLICATION OF COST-EFFECTIVENESS TO THE DESIGN OF A FLOOD PLAIN,

G.M. CLARK

- 6.0347 DETERMINATION OF COST-EFFECTIVE TECHNICAL PROCEDURES FOR USE IN THE OHIO FLOOD PLAIN MANAGEMENT PROGRAM,

G.M. CLARK

- 6.0348 STREAMFLOW SIMULATION AND FLOOD PROFILE DETERMINATION IN OHIO - A PILOT STUDY,

V.T. RILCA

OREGON STATE UNIVERSITY
WATER RESOURCES RESEARCH INST.

- 6.0353 A COMPILATION OF FLOOD ABATEMENT PROJECTS IN OREGON,

R.E. EMMER

PAIM BEACH CO. AREA PLAN. BD.

- 6.0235 FLOOD PLAIN STUDY AND MODEL. FLOOD PLAIN ORDINANCE,

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UNKNOWN

PENN. STATE UNIVERSITY
INST. RES. LAND & WTR. RESOUR.

- 6.0144 OPTIMAL ANTECEDENT PRECIPITATION INDICES FOR SMALL EASTERN WATERSHEDS,

B.M. REICH

- 6.0146 FLOOD SERIES FOR GAGED PENNSYLVANIA STREAMS,

B.M. REICH

- 6.0360 SOCIOLOGICAL IMPACT OF A FLOOD-CONTROL RESERVOIR,

S.M. LEADLEY

- 6.0361 EFFECT OF AGNES FLOODS ON ANNUAL SERIES IN PENNSYLVANIA,

B.M. REICH

PENN. STATE UNIVERSITY
SCHOOL OF ENGINEERING

- 6.0145 FLOOD PREDICTION METHODS FOR PENNSYLVANIA

PURDUE UNIVERSITY
SCHOOL OF CIVIL ENGINEERING

- 6.0271 WABASH RIVER SYSTEMS MODEL. PROJECT MANAGEMENT, PLANNING AND

PURDUE UNIVERSITY
SCHOOL OF ENGINEERING

- 6.0270 THE EFFECT OF URBANIZATION ON THE HYDROLOGY OF WATERSHEDS - INDIANA,

PURDUE UNIVERSITY
WATER RESOURCES RESEARCH CENTER

- 6.0088 INITIAL RESULTS FROM THE SIMULATION MODEL,

- 6.0269 HYDRAULICS OF SHALLOW FLOODABLE ERODED SAND SURFACES DESIGN SPECTRA,

RESOURCES DEVELOPMENT CENTER

- 6.0191 SOCIALLY DEFINED ENVIRONMENTAL PROBLEMS IN URBAN WATER RESOURCES PLANNING

RUTGERS THE STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION

- 6.0323 HYDROLOGY OF SUBURBAN AREAS - NEW JERSEY,

RUTGERS THE STATE UNIVERSITY
WATER RESOURCES RESEARCH CENTER

- 6.0324 ECONOMIC BASIS FOR WATER RESOURCES ANALYSIS,

SAN DIEGO CO. COMP. PLAN. DIV.

- 6.0046 DRAINAGE AND FLOOD CONTROL BACKGROUND AND POLICY STUDY -

- 6.0047 INITIAL WATER, SEWERAGE AND

SAN DIEGO REG. COMP. PLAN. DIV.

- 6.0181 DRAINAGE AND FLOOD CONTROL BACKGROUND AND POLICY STUDY REPORT,

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- 6.0145 A STUDY FOR ECONOMIC DEVELOPMENT

SOUTH DAKOTA STATE UNIVERSITY
REMOTE SENSING INSTITUTE6.0030 MONITORING FLOOD DAMAGE WITH SATEL-
LITE IMAGERY,

L.A. BENSON

SOUTHWESTERN ILL. PLAN. COMM.

6.0084 BACKGROUND SURVEY - SURFACE DRAINAGE
PROGRAM, MADISON, ST. CLAIR, MONROE AND
RANDOLPH COUNTIES, ILLINOIS,

UNKNOWN

STATE COMM. & AREA DEV. DIV.

6.0309 ZONING ORDINANCE AND SUBDIVISION REGU-
LATIONS, FRIARS POINT, MISSISSIPPI,

P.J. BARLOW

STATE DEPT. OF BUS. & DEV.

6.0262 PRIORITY AND PLANNING ELEMENTS FOR
DEVELOPING ILLINOIS WATER RESOURCES,

UNKNOWN

STATE DEPT. OF COMMUNITY AFFS.

6.0295 RE-DRAFT OF SEEKONK ZONING BY LAW, 15
NOVEMBER 1969,

J. BLACKWELL

STATE DEPT. OF ENV. CONSERV.

6.0130 REGIONAL COMPREHENSIVE MULTI-PURPOSE
WATER RESOURCES PLANNING STUDIES IN NEW
YORK,

J.A. FINCK

6.0131 USE OF SYSTEMS ANALYSIS IN THE DEVELOP-
MENT OF WATER RESOURCES MANAGEMENT PLANS
FOR NEW YORK STATE - ADDENDUM,

C.S. LIU

STATE DEPT. OF PUB. WELFARE

6.0008 MENTAL HEALTH SERVICES TO RESIDENTS OF
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MONWEALTH OF PENNSYLVANIA,

UNKNOWN

STATE DEPT. OF TRANSPORTATION

6.0043 FLOODS FROM SMALL DRAINAGE AREAS IN
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A.O. WAANANEN

STATE DEPT. OF WATER RESOURCES

6.0044 SOUTH COASTAL BASIN PRECIPITATION
FREQUENCY - A REGIONAL ANALYSIS OF DEPTH-DU-
RATION FREQUENCY OF SHORT-DURATION
PRECIPITATION IN CALIFORNIA,

J.D. GOODRIDGE

STATE DIV. OF MINES & GEOLOGY

6.0045 URBAN GEOLOGY PLAN FOR CALIFORNIA -
THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC
HAZARDS & RECOMMENDATIONS FOR THEIR
MITIGATION (ABBREV),

J.T. ALFORE

STATE DIV. OF VOC. REHAB.

6.0014 DELIVERING VOCATIONAL REHABILITATION
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W.R. PHELPS

STATE DIV. OF WATER RESOURCES

6.0328 THE USE OF SYSTEMS ANALYSIS IN THE
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MENT PLANS FOR NEW YORK STATE - VOLUME I,

A.C. FEDROW

STATE GEOL. SURVEY

6.0035 ELEMENTS OF THE WATER RESOURCES SITUA-
TION IN ALABAMA,

D.B. KNOWLES

STATE HIGHWAY COMMISSION

6.0287 SMALL STREAMS FLOOD FREQUENCY IN
MAINE,

G.S. HAYES

STATE OFF. OF PLAN. SERVICES

6.0329 STREAMS AND DRAINAGE BASINS - FULTON
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UNKNOWN

6.0330 PUTNAM COUNTY OFFICIAL MAP - PROPOSALS
FOR REVISION AND EXPANSION,

UNKNOWN

STATE PLANNING & COM. AFF. AGY

6.0253 NATURAL DISASTER ANALYSIS FOR LATAH
COUNTY, IDAHO, JUNE 1973,

H.W. LEE

STATE PLANNING & GRANTS DIV.

6.0363 MYRTLE BEACH, S.C. - COMPREHENSIVE
DEVELOPMENT PLAN,

UNKNOWN

STATE PLANNING BOARD

6.0362 FLOOD CONTROL STUDY OF RIO GRANDE DE
MANATI, MANATI AND BARCELONETA, PUERTO
RICO,

UNKNOWN

STATE PLANNING COMMISSION

6.0369 ZONING ORDINANCE, HUNTINGDON, TENNES-
SEE,

UNKNOWN

6.0284 ZONING ORDINANCE - PAINTSVILLE, KENTUCKY.

UNKNOWN

STATE UNIVERSITY OF NEW YORK
AGRICULTURAL EXPERIMENT STA.

6.0336 THE POLITICAL ECONOMY OF WATER RESOURCES.

DJ ALLEE

6.0337 APPLICATION OF LUNR SYSTEM TO FLOOD PLAIN ANALYSIS AND MANAGEMENT IN THE OSUSQUEHANNA RIVER BASIN.

J.W. KELLEY

STATE WATER RESOUR. BOARD

6.0350 APPRAISAL OF THE WATER AND RELATED LAND RESOURCES OF OKLAHOMA - REGION EIGHT - 1971.

UNKNOWN

6.0351 APPRAISAL OF THE WATER AND RELATED LAND RESOURCES OF OKLAHOMA.

UNKNOWN

STATE WATER SURVEY

6.0263 STREAMFLOW VARIABILITY - ILLINOIS.

K.P. SINGH

STEPHENSON CO. PLANNING COMM.

6.0260 A COMPREHENSIVE PLAN FOR STEPHENSON COUNTY, ILLINOIS.

UNKNOWN

TAMPA BAY REGIONAL PLAN. COUN.

6.0231 SARASOTA - ZONING AND SUBDIVISION CONTROLS - REVIEW, ANALYSIS, AND RECOMMENDATIONS CONCERNING CURRENT REGULATIONS.

E.R. BARTLEY

6.0232 ZONING REGULATIONS OF THE CITY OF SARASOTA, FLORIDA.

UNKNOWN

TEXAS A & M UNIVERSITY SYSTEM
SCHOOL OF ENGINEERING

6.0151 ALTERNATE SOLUTIONS TO WATER RESOURCE DEVELOPMENT - A CASE STUDY - TEXAS.

D.R. BASCO

TEXAS A & M UNIVERSITY SYSTEM
WATER RESOURCES INSTITUTE

6.0379 WATER FOR TEXAS - URBAN WATER RESOURCES PLANNING AND MANAGEMENT - THE PROCEEDINGS OF THE ANNUAL CONFERENCE HELD AT SAN ANTONIO (ABBREV).

UNKNOWN

TEXAS TECHNOLOGICAL UNIVERSITY
WATER RESOURCES CENTER

TEXAS REGIONAL PLANNING COMM.
6.0381 SOIL AND WATER CONSERVATION NEEDS IN VENTORY, COOKE, GRAYSON AND FANNIN COUNTIES, TEXAS.

UNKNOWN

TUSCALOOSA AREA COUN. OF GOV.

6.0159 FLOOD MANAGEMENT STUDY.

UNKNOWN

6.0160 FLOOD MANAGEMENT STUDY - TUSCALOOSA, PICKENS COUNTY AND MOUNDSVILLE, ALABAMA, MAY 1971.

UNKNOWN

U.S. AIR FORCE
AIR WEATHER SERVICE

6.0081 WATER WARNINGS AND SPECIALIZED FORECASTS.

UNKNOWN

U.S. ARMY
CORPS OF ENGINEERS

6.0053 CHENA RIVER LAKES PROJECT, ALASKA - PROBLEMS RELATING TO CHANNEL DEVELOPMENT, EROSION, & BANK & LEVEE PROTECTION.

C.P. LINDNER

6.0054 JACKSON HOLE FLOOD CONTROL PROJECT.

UNKNOWN

6.0405 FLOOD HAZARD INFORMATION - BUFFALO CREEK, LOGAN COUNTY, WEST VIRGINIA POST-DISTURBANCE CONDITIONS.

UNKNOWN

U.S. ARMY
ENGINEER DISTRICT

6.0033 SPEWRELL BLUFF LAKE, FLINT RIVER, GEORGIA.

UNKNOWN

6.0096 GRAND ISLE, LOUISIANA, AND VICINITY HURRICANE PROTECTION ASSOCIATED WATER FEATURE, BAYOU LAFOURCHE - LOUISIANA (ABBREV).

UNKNOWN

6.0097 NEW ORLEANS TO VENICE, LOUISIANA, HURRICANE PROTECTION.

UNKNOWN

6.0098 LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY - HURRICANE PROTECTION PROJECT.

UNKNOWN

6.0099 MORGAN CITY, LOUISIANA, AND VICINITY (FRANKLIN AND VICINITY AREA).

UNKNOWN

6.0100 RED RIVER EMERGENCY BANK PROTECTION, LOUISIANA, ARKANSAS, AND TEXAS.

UNKNOWN

6.0141 BIG HILL LAKE, BIG HILL CREEK, KANSAS.

UNKNOWN

6.0142 BIRCH LAKE, BIRCH CREEK, OKLAHOMA.

UNKNOWN

6.0172 SANTA ANA RIVER BASIN, FLOOD CONTROL PROJECT, EAST TWIN AND WARM CREEK IMPROVEMENT,

UNKNOWN

6.0315 FORT SCOTT LAKE, MARMAION RIVER, KANSAS,

UNKNOWN

6.0320 MERAMEC PARK LAKE, UPPER MISSISSIPPI RIVER BASIN, MERAMEC RIVER, MISSOURI,

UNKNOWN

6.0358 FLOOD-PROOFING REGULATIONS,

UNKNOWN

U.S. ARMY
ENGINEERING DIVISION

6.0095 HYDROLOGIC STUDIES (STORM STUDIES),

B.J. GARRETT

U.S. ARMY
HYDROLOGIC ENGINEERING CENTER

6.0037 HYDROLOGIC ENGINEERING METHODS FOR WATER RESOURCES DEVELOPMENT - VOLUME 1 - REQUIREMENTS AND GENERAL PROCEDURES,

L.R. BEARD

6.0038 RESERVOIR SYSTEMS ANALYSIS FOR FLOOD CONTROL,

B.S. EICHERT

6.0167 STOCHASTIC HYDROLOGY,

H.E. KUBIK

U.S. ARMY
LOWER MISS. VALLEY DIV.

6.0121 FLOOD CONTROL IN THE LOWER MISSISSIPPI RIVER VALLEY,

UNKNOWN

U.S. ARMY
NEW ENGLAND DIVISION

6.0108 HURRICANE PROTECTION PROJECT, STRATFORD, CONNECTICUT,

UNKNOWN

6.0109 OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, MASSACHUSETTS,

UNKNOWN

6.0110 OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, NEW BEDFORD, MASSACHUSETTS,

UNKNOWN

6.0111 NEW LONDON HURRICANE PROTECTION PROJECT, NEW LONDON, CONNECTICUT,

UNKNOWN

U.S. ARMY
WATERWAYS EXPERIMENT STATION

6.0116 DESIGN FOR FLOOD CONTROL AND PROTECTION, CHAGRIN RIVER, EASTLAK HYDRAULIC MODEL INVESTIGATION,

C.E.

6.0117 DISCHARGE CHARACTERISTICS OF HURRICANE BARRIER, EAST PASSAGE OF NARRAGANSETT BAY, RHODE ISLAND - HYDRAULIC MODEL INVESTIGATION,

G.A.

6.0118 ANSONIA-DERBY LOCAL PROTECTION PROJECT, NAUGATUCK AND HOUSATONIC RIVERS, CONNECTICUT - HYDRAULIC MODEL INVESTIGATION,

G.A.

6.0119 PROTECTION OF NARRAGANSETT BAY FROM HURRICANE SURGES,

H.B.

6.0120 FLOOD-CONTROL PROJECT HOOSIATUCK RIVER, NORTH ADAMS MASSACHUSETTS,

6.0312 MODEL STUDY OF CANNELTON LOCK AND DAM, OHIO RIVER, INDIANA AND KENTUCKY,

J.

6.0313 MISSISSIPPI BASIN MODEL,

6.0314 DEMONSTRATION OF THE ELECTRIC MODEL OF THE KANSAS RIVER AT THE UNIVERSITY OF CALIFORNIA IN BERKELEY,

U.S. COASTAL BEND REG. COMM.

6.0380 OSO CREEK TECHNICAL ASSISTANCE PROJECT - PRELIMINARY STUDY ON THE PROBLEMS AND OPPORTUNITIES FOR DEVELOPMENT OF OSO AND OSO BAY,

U.S. DEPT. OF AGRICULTURE
BLACKLAND EXPERIMENT WATERSHED

6.0388 RELATION OF CLIMATIC AND WATER CHARACTERISTICS TO STORM RUNOFF IN THE BLACKLANDS PLATEAU - TEXAS,

W.

U.S. DEPT. OF AGRICULTURE
NATURAL RESOURCE ECON. DIV.

6.0194 ANALYSIS OF LAND USE CONTROL MEASURES,

W.D.

U.S. DEPT. OF AGRICULTURE
PAC. S.W. FOR. & RE. EXP. STA.

U.S. DEPT. OF AGRICULTURE
SOIL CONSERVATION SERVICE

- 6.0055 HURRICANE CREEK WATERSHED PROJECT,
HUMPHREYS AND DICKSON COUNTIES, TENNESSEE,
UNKNOWN
- 6.0195 KANSAS - NORTH SECTOR UPPER WALNUT
WATERSHED BUTLER AND CHASE COUNTIES,
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- 6.0196 UNION CREEK WATERSHED PROJECT, SOUTH
DAKOTA,
UNKNOWN
- 6.0197 HOLLOW CREEK WATERSHED PROJECT,
SOUTH CAROLINA,
UNKNOWN
- 6.0198 KANSAS - NORTH SECTOR UPPER WALNUT
WATERSHED BUTLER AND CHASE COUNTIES,
UNKNOWN
- 6.0199 NUTWOOD WATERSHED, ILLINOIS,
UNKNOWN
- 6.0200 HURRICANE CREEK WATERSHED STRUCTURAL
PROJECT MEASURE, KENTUCKY,
UNKNOWN
- 6.0201 CORNUDAS, NORTH AND CULP DRAWS
WATERSHED, HUDSPETH COUNTY, TEXAS, AND
OTERO COUNTY, NEW MEXICO,
UNKNOWN
- 6.0202 BIG CREEK WATERSHED, KANSAS,
UNKNOWN
- 6.0203 MACADOO ROAD-FILL DAM, KANSAS,
UNKNOWN
- 6.0204 STARKWEATHER WATERSHED, NORTH
DAKOTA,
UNKNOWN
- 6.0205 VERDE LANE FLOOD PREVENTION PROJECT
MEASURE, NEBRASKA,
UNKNOWN
- 6.0206 WHITEWATER CREEK HYDROLOGIC UNIT PRO-
JECT MEASURE, CHEROKEE HILLS RC AND D PRO-
JECT, OKLAHOMA,
UNKNOWN

U.S. DEPT. OF COMMERCE
EQUIPMENT DEVELOPMENT LAB.

- 6.0104 HYDROLOGIC EQUIPMENT - FLASH FLOOD
ALARM SYSTEM,

W. STAATS

U.S. DEPT. OF COMMERCE
LIMNOLOGY DIVISION

- 6.0207 LAKE HYDROLOGY,

L. BAJORUNAS

U.S. DEPT. OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS

6.0103 HYDROLOGIC DATA COLLEC-
TIONARY SATELLITE.

- 6.0290 PROBABLE MAXIMUM PRECIPITATION
SNOWMELT CRITERIA FOR RIVER
NORTH ABOVE PEMBINA AND SOUR
MINOT, NORTH DAKOTA.

U.S. DEPT. OF COMMERCE
NATL. BUREAU OF STANDARDS

- 6.0001 DISASTER INVESTIGATIONS,

U.S. DEPT. OF COMMERCE
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- 6.0056 BLACK HILLS FLOOD OF JUNE 1950,

- 6.0057 ESSA AND OPERATION FORECASTER

- 6.0289 CLIMATES OF THE STATES - C
YORK,

U.S. DEPT. OF COMMERCE
NATL. WEATHER SERVICE

- 6.0391 FLASH FLOOD FORECASTING
PROGRAM IN THE WESTERN REGION

U.S. DEPT. OF COMMERCE
TECHNIQUES DEVELOPMENT

- 6.0006 FLOOD INSURANCE STUDY,

U.S. DEPT. OF COMMERCE
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- 6.0021 METEOROLOGICAL AND
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- 6.0022 THE METEOROLOGICAL AND
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- 6.0024 LOCK HAVEN URBAN RENEWAL
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- 6.0025 MODEL CITIES ONE - URBAN
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6.0029 KINGSTON DISASTER URBAN RENEWAL PROJECT, BOROUGH OF KINGSTON, LUZERNE COUNTY, PENNSYLVANIA, HUD PROJECT NO. R-615C,

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6.0027 MILTON SOUTH, MILTON NORTH AND TURBOY TOWNSHIP DISASTER, URBAN RENEWAL PROJECTS, PENNSYLVANIA,

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6.0028 DOWNTOWN URBAN RENEWAL PROJECT, WILKES-BARRE, PENNSYLVANIA,

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6.0020 FLOOD OF JULY 17, 1972 IN GALLUP, NEW MEXICO,

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6.0023 FLOOD FREQUENCY AND HIGH-FLOW STUDIES,

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6.0034 FLOOD-FREQUENCY SYNTHESIS FOR SMALL STREAMS - ALABAMA,

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6.0039 EFFECTS OF URBAN DEVELOPMENT AND WATER USE ON THE SANTA ANA RIVER, CALIFORNIA,

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6.0049 PEAK DISCHARGE AND FREQUENCY FOR SMALL WATERSHEDS IN COLORADO,

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6.0058 FLOOD FLOWS FROM SMALL DRAINAGE AREAS,

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6.0059 INVESTIGATION AND ANALYSIS OF FLOODS FROM SMALL DRAINAGE AREAS IN OHIO,

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6.0065 FLOOD FREQUENCY IN SMALL DRAINAGE AREAS - MISSISSIPPI,

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6.0067 HYDROLOGIC AND BIOLOGIC STUDIES OF SOUTHWEST FLORIDA (BIG CYPRESS),

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6.0068 RESPONSE OF WATER LEVELS TO FLOOD CONTROL OPERATIONS IN SOUTHEASTERN FLORIDA,

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6.0069 HYDROLOGIC BASE FOR WATER MANAGEMENT, DADE COUNTY, FLORIDA,

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6.0071 ESTUARINE HYDROLOGY OF TAMPA BAY,

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6.0075 FLOOD HYDROLOGY ON SMALL DRAINAGE AREAS IN GEORGIA,

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6.0082 FLOOD FLOWS FROM SMALL DRAINAGE BASINS IN ILLINOIS,

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6.0090 STREAMFLOW CHARACTERISTICS, KANSAS,

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6.0091 FLOOD INVESTIGATIONS - HIGHWAY COMMISSION - KANSAS,

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6.0093 FLOOD-FREQUENCY STUDY - KENTUCKY,

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6.0094 FLOOD FREQUENCY OF SMALL STREAMS IN LOUISIANA,

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6.0102 FLOODS FROM SMALL DRAINAGE AREAS - MARYLAND,

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6.0106 FLOOD FLOW CHARACTERISTICS OF SMALL BASINS IN MASSACHUSETTS,

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6.0114 BRIDGE SITE INVESTIGATIONS,

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6.0115 SPECIAL FLOOD REPORTS - MISSISSIPPI,

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6.0129 INVESTIGATION AND ANALYSIS OF FLOODS FOR SMALL DRAINAGE AREAS IN NEW MEXICO,

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6.0134 EFFECTS OF URBANIZATION ON FLOODS AT WINSTON-SALEM, NORTH CAROLINA,

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6.0140 INVESTIGATION AND ANALYSIS OF FLOODS
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6.0143 TEST OF THE ERTS-DATA COLLECTION
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6.0147 FLOOD INVESTIGATIONS - TENNESSEE,

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6.0149 HYDROLOGIC INVESTIGATION OF SMALL
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6.0164 APPLICATIONS OF AERIAL MEASUREMENTS
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6.0168 PERRIS VALLEY URBAN HYDROLOGY STUDY,
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6.0169 URBAN HYDROLOGY OF POWAY VALLEY,
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6.0176 FLOODS FROM SMALL DRAINAGE AREAS -
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6.0184 DENVER METROPOLITAN AREA, COLORADO,

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6.0188 HAMILTON 2 DEGREE,

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- 6.0254 MAGNITUDE AND FREQUENCY OF FLOODS IN
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- 6.0255 DEPTH AND FREQUENCY OF FLOODS IN IL-
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- 6.0256 FLOOD FREQUENCY STUDY ILLINOIS,
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- 6.0372 URBAN HYDROLOGY STUDY - AUSTIN, TEXAS,
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6.0376 EFFECTS OF URBANIZATION ON FLOODS IN THE HOUSTON, TEXAS METROPOLITAN AREA.

S.L. JOHNSON

6.0377 URBAN HYDROLOGY STUDY - SAN ANTONIO, TEXAS.

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6.0382 URBAN HYDROLOGY STUDY, DALLAS, TEXAS.

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6.0383 URBAN HYDROLOGY STUDY - FORT WORTH, TEXAS.

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6.0384 URBAN HYDROLOGY STUDY - DALLAS COUNTY, TEXAS.

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6.0386 URBAN HYDROLOGY STUDY - HOUSTON, TEXAS.

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6.0389 URBAN HYDROLOGY STUDY, SAN ANTONIO, TEXAS.

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6.0392 MAGNITUDE AND FREQUENCY OF FLOODS IN UTAH.

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6.0394 TECHNIQUES OF FLOOD-PLAIN MAPPING FOR LAND-USE MANAGEMENT OF FLOOD PLAINS.

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6.0395 SEDIMENT MOVEMENT AND HILLSLOPE MORPHOLOGY IN THE CENTRAL APPALACHIAN REGION - VIRGINIA.

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6.0400 URBAN HYDROLOGY OF STREAMS IN FAIRFAX COUNTY.

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6.0401 URBAN FLOOD HYDROLOGY OF STREAMS IN FAIRFAX COUNTY, VIRGINIA.

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6.0404 FLOOD PROFILES AND INUNDATED AREAS ALONG THE SKOKOMISH RIVER, WASHINGTON.

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6.0228 OHIO RIVER BASIN SURVEY.
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M. SNIEDOVICH

UNIV. OF CALIFORNIA
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6.0166 THE IMPACT OF URBANIZATION ON WATER YIELD, FLOOD PEAK, SEDIMENT YIELD, AND WATER QUALITY IN THE BERKELEY HILLS, CALIFORNIA.

J.R. MCBRIDE

UNIV. OF CALIFORNIA
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C. HETRICK

UNIV. OF CHICAGO
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6.0257 COMMUNITY GOALS - MANAGEMENT OPPORTUNITIES - AN APPROACH TO FLOOD PLAIN MANAGEMENT.

J.R. SHEAFFER

UNIV. OF DELAWARE
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R.F. MINNEHAN

UNIV. OF FLORIDA
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6.0066 AN OPTIMUM WATER ALLOCATION MODEL BASED ON AN ANALYSIS FOR THE KISSIMMEE RIVER BASIN - FLORIDA.

J.E. REYNOLDS

UNIV. OF HAWAII
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C.M. FULLERTON

UNIV. OF HAWAII
SCHOOL OF ARTS

6.0252 HAWAII ENVIRONMENTAL SIMULATION MODEL.

D.C. COX

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WATER RESOURCES RESEARCH CTR.

6.0076 URBAN HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII.

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6.0077 FLOOD HYDROLOGY AND URBAN WATER RESOURCES OF THE ISLAND OF OAHU, HAWAII.

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6.0078 INSTANTANEOUS UNIT HYDROGRAPH ANALYSIS OF HAWAIIAN SMALL WATERSHEDS.

R. WANG

UNIV. OF IDAHO
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6.0080 A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS - REPORT ON FLOOD CONTROL SUBPROJECT - IDAHO.

J.J. PEEBLES

UNIV. OF ILLINOIS
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B.A. JONES

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B.A. JONES

UNIV. OF ILLINOIS
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6.0086 OAKLEY-SANGAMON REMOTE SENSING ENVIRONMENTAL RESEARCH PROGRAM - ILLINOIS.

H.M. KARARA

6.0264 EVALUATION OF FLOOD RISKS.

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6.0267 HYDROLOGIC MODELS OF THE GREAT LAKES.

D.D. MEREDITH

UNIV. OF GEORGIA

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- 6.0018 URBAN GROWTH, RUNOFF, EXTERNALITIES,
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J.R. BARNARD

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- 6.0004 FACTORS AFFECTING RELOCATION IN
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- 6.0019 THE GENERATION OF FLOOD DAMAGE TIME
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- 6.0092 STREAMFLOW PATTERNS WATERSHED
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L.D. JAMES

- 6.0285 OPSET - PROGRAM FOR COMPUTERIZED
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- 6.0293 LEGAL ISSUES ON ECONOMIC UTILIZATION OF
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- 6.0291 ECONOMIC AND LEGAL ANALYSIS OF ALTER-
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J.H. FOSTER

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- 6.0292 DETERMINATION OF DECISION MAKING
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E.R. KAYNOR

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- 6.0105 FLOOD PROOFING DECISIONS UNDER UNCER-
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- 6.0070 STUDIES OF THE RED ALGAL
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- 6.0112 RAINFALL-RUNOFF RELATION
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- 6.0306 SOCIO-ECONOMIC IMPLICATIONS
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ST. ANTHONY FALLS HYDROLOGICAL

- 6.0113 FORECASTING RAINFALL AND
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- 6.0301 FLOOD FORECASTING IN THE
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- 6.0123 OPTIMIZATION OF OPERATION
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- 6.0122 SPILLWAY DESIGN FLOODS FOR
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6.0322 EVALUATION OF FLOOD PEAK PREDICTION METHODS IN SEMI-ARID REGIONS IN RELATION TO DAM SAFETY.

A.B. CUNNINGHAM

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6.0137 USE OF MULTISPECTRAL PHOTOGRAPHY IN WATER RESOURCE PLANNING AND MANAGEMENT IN NORTH CAROLINA.

C.W. WELBY

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6.0341 EROSION AND DEPOSITION IN THE SOUNDS AND ESTUARIES OF THE NORTH CAROLINA COAST.

R.L. INGRAM

UNIV. OF PITTSBURGH
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6.0359 ALTERNATIVE ADJUSTMENTS TO NATURAL HAZARDS.

D.G. AREY

UNIV. OF TEXAS
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6.0378 TECHNIQUE FOR PROJECTING ALTERNATIVE FUTURES FOR WATER RESOURCE PLANNING.

L.R. BEARD

UNIV. OF TEXAS
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6.0150 OPTIMAL FLOOD ROUTING USING STOCHASTIC DYNAMIC PROGRAMMING.

W.S. RUTCHER

UNIV. OF VERMONT
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6.0393 SURVEY OF LAKE FLOODING FROM ERTS-1 - LAKE CHAMPLAIN.

A.O. LIND

UNIV. OF WISCONSIN
SCHOOL OF AGRICULTURE

6.0412 REMOTE SENSING FOR RESOURCE MANAGEMENT AND FLOOD PLAIN DELINEATION.

C.J. MILFRED

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WATER RESOURCES CENTER

6.0410 WATER RESOURCES POLICY IN WISCONSIN - VOLUME IV - FLOOD PLAIN MANAGEMENT.

J.A. KUSLER

6.0413 THE USE OF DETAILED SOILS INFORMATION FOR DELINEATING AND REGULATING FLOOD PLAINS - LEGAL AND ADMINISTRATIVE CONSIDERATIONS.

D.A. YANGGEN

UNKNOWN INST. OR INDIV. GRANT

6.0155 REVIEW EMERGENCY RELIEF FILES AND SURVEY THE TREND OF BRIDGE LOSSES DURING STORM CONDITIONS.

F. CHANG

6.0355 AN EVALUATION OF HURRICANE AGNES FLOODS IN COMPARISON TO BRIDGE DESIGN INFORMATION AVAILABLE FOR PENNSYLVANIA CONTEMPORANEOUSLY.

B.M. REICH

6.0356 COMPARISON OF RECENTLY PUBLISHED FORMULAE FOR FLOOD FREQUENCY IN PENNSYLVANIA.

B.M. REICH

UPPER MISS. RIV. COMP. COMM.

6.0017 UPPER MISSISSIPPI RIVER COMPREHENSIVE BASIN STUDY - VOLUME V, APPENDIX 10. FLOOD CONTROL.

UNKNOWN

UTAH STATE UNIVERSITY
INST. FOR SOCIAL SCIENCE RES.

6.0390 DEFINING THE ELEMENTS OF THE SOCIOLOGICAL SYSTEM RELATED TO DRAINAGE PROBLEMS OF URBAN AREAS.

W.H. ANDREWS

UTAH STATE UNIVERSITY
SCHOOL OF SOCIAL SCIENCE

6.0153 MODELING THE TOTAL HYDROLOGIC-SOCIOLOGIC FLOW SYSTEM OF URBAN AREAS - PHASE III.

W.H. ANDREWS

UTAH STATE UNIVERSITY
UTAH CTR. FOR WTR. RESOUR. RES

6.0031 STUDIES IN CONNECTION WITH HYDROLOGIC AND RELATED PHYSICAL PROCESSES IN THE OLYMPUS COVE AREA OF SALT LAKE COUNTY.

J.P. RILEY

6.0154 PRESENT AND POTENTIAL MULTIPLE USES OF CANAL SYSTEMS - PHASE I.

K. UNHANAND

VALLEY REGIONAL PLANNING AGCY.

6.0192 RECOMMENDED REGIONAL PLAN FOR SEWERAGE, WATER SUPPLY AND STORM DRAINAGE - CONNECTICUT.

UNKNOWN

VIRGINIA POLYTECHNIC INSTITUTE
GRADUATE SCHOOL

6.0013 EVALUATION OF FLOOD INSURANCE IN A DIS-
ASTER AREA,

W.R. WALKER

VIRGINIA POLYTECHNIC INSTITUTE
SCHOOL OF AGRICULTURE

6.0397 PUBLIC CHOICE AND THE DISTRIBUTION OF
BENEFITS AND COSTS OF FLOOD PLAIN REGULA-
TION - VIRGINIA,

L.A. SHABMAN

VIRGINIA POLYTECHNIC INSTITUTE
SCHOOL OF ENGINEERING

6.0396 NUMERICAL STUDIES OF UNSTEADY FLOW IN
THE JAMES RIVER - VIRGINIA,

D.N. CONTRACTOR

VIRGINIA POLYTECHNIC INSTITUTE
WATER RESOURCES RESEARCH CTR.

6.0012 PROCEEDINGS - COMMUNITY WORKSHOP ON
FLOOD INSURANCE,

J.E. HACKETT

6.0398 FLOOD DAMAGE ABATEMENT- FEDERAL
ASSISTANCE TO LOCAL GOVERNMENT,

W.R. WALKER

6.0399 FLOOD DAMAGE ABATEMENT STUDY FOR VIR-
GINIA,

W.R. WALKER

W.A. WAILER & ASSOCIATES

6.0015 ANALYSIS OF COAL REFUSE DAM FAILURE
MIDDLE FORK BUFFALO CREEK, SAUNDERS, WEST
VIRGINIA - VOLUME I,

UNKNOWN

6.0040 ANALYSIS OF COAL REFUSE DAM FAILURE
MIDDLE FORK BUFFALO CREEK, SAUNDERS, WEST
VIRGINIA - VOLUME II, APPENDICES,

UNKNOWN

WASHINGTON STATE UNIVERSITY
SCHOOL OF ENGINEERING

6.0402 PILOT STUDY OF FLOOD PLAIN MANAGEMENT
- WASHINGTON,

J.F. ORSBORN

WEST VA. UNIVERSITY
WATER RESEARCH INSTITUTE

HAIL

BATTELLE MEMORIAL

7.0017 TRACER STUDIES IN
RESEARCH EXPERIMENT (NIR)

COLORADO STATE U
SCHOOL OF ENGINEERING

7.0013 EXTENDED AREA RESEARCH
WEATHER MODIFICATION,

NATL. CENTER FOR AT

7.0010 NATIONAL HAIL RESEARCH
PORT FOR 1973 - COLORADO,

7.0011 THE NATIONAL HAIL RESEARCH
SUMMER 1973 SUMMARY REPORT

NORTH DAKOTA STATE
AGRICULTURAL EXPERIMENT

7.0006 WEATHER MODIFICATION
HAIL

PURDUE UNIVERSITY
AGRICULTURAL EXPERIMENT

7.0004 SOYBEAN PHYSIOLOGY AND

STATE DIV. OF MINES &

7.0009 URBAN GEOLOGY PLAN
THE NATURE, MAGNITUDE, & C
HAZARDS & RECOMMENDATIONS
MITIGATION (ABBREV),

STATE WATER SURVEY

7.0003 A STUDY OF CROP-HAIL IN
FOR NORTHEASTERN COLORADO
THE DESIGN OF THE NATIONAL

7.0008 STUDIES OF HAIL DATA IN

U.S. DEPT. OF AGRICULTURE
ECONOMIC & STAT. ANALYSIS

U.S. DEPT. OF AGRICULTURE
ECONOMIC RESEARCH SERVICE

7.0007 ECONOMIC AND INSTITUTIONAL CONSIDERATIONS OF SUPPRESSING HAIL.

L.M. BOONE

U.S. DEPT. OF AGRICULTURE
FARM PRODUCTION ECONOMICS DIV.

7.0002 MEASUREMENT AND ANALYSIS OF FARM RISKS, LOSSES, AND INSURANCE.

L.A. JONES

U.S. DEPT. OF COMMERCE
ENVIRON. RESEARCH LABORATORIES

7.0012 HAIL AND LIGHTNING - COLORADO.

H. WEICKMANN

U.S. DEPT. OF COMMERCE
NATL. WEATHER SERVICE

7.0016 THUNDERSTORMS AND HAIL DAYS PROBABILITIES IN NEVADA.

C.M. SAKAMOTO

U.S. NATL. SCIENCE FOUNDATION

7.0014 NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING.

UNKNOWN

UNIV. OF ILLINOIS
SCHOOL OF LIBERAL ARTS

7.0015 DESIGN OF HAIL SUPPRESSION EXPERIMENT IN ILLINOIS.

G.M. MORGAN

UNIV. OF NEBRASKA
U.S.D.A. NAT. RESOUR. EC. DIV.

7.0005 ECONOMIC AND INSTITUTIONAL CONSIDERATIONS OF SUPPRESSING HAIL.

L. BOONE

UNIV. OF WISCONSIN
SCHOOL OF NATURAL SCIENCES

7.0018 STUDY OF THE FEATURES AND ENERGY BUDGETS OF NORTHEASTERN COLORADO HAIL-STORMS - ALSO, WISCONSIN.

C.E. ANDERSON

HURRICANES

COAST CODE ADMINISTRATION

8.0010 REGIONAL CODE ENFORCEMENT - HANCOCK, HARRISON AND JACKSON COUNTIES, MISSISSIPPI.
P. MONTJOY

COLORADO STATE UNIVERSITY SCHOOL OF ENGINEERING

8.0066 INVESTIGATION OF SATELLITE OBSERVED TYPHOON-HURRICANE CLOUD CLUSTERS AND FLOW FEATURES.

W.M. GRAY

8.0067 STUDIES OF CUMULUS HEATING AND THE CISK MECHANISM.

W.M. GRAY

8.0068 HURRICANE SPAWNED TORNADOES.

D.J. NOVLAN

8.0069 THE STRUCTURE AND DYNAMICS OF THE HURRICANE'S INNER CORE REGION.

D.J. SHEA

GULF UNIV. RES. CONSORTIUM

8.0049 THE USE OF GRASSES FOR DUNE STABILIZATION ALONG THE GULF COAST WITH INITIAL EMPHASIS ON THE TEXAS COAST.

T.W. BILHORN

HARVARD UNIVERSITY SCHOOL OF ARTS

8.0117 NAVY ENVIRONMENT - FLUID MECHANICS RESEARCH.

G.F. CARRIER

INST. FOR DEFENSE ANALYSIS

8.0017 NATURAL DISASTERS OPERATIONS PLANNING FOR SLOWLY DEVELOPING DISASTERS, VOLUME I.

A. SACHS

JOHNS HOPKINS UNIVERSITY GRADUATE SCHOOL

8.0009 ASSESSMENT OF THE PHYSICAL AND GEOLOGICAL EFFECTS OF TROPICAL STORM AGNES ON THE UPPER CHESAPEAKE BAY AND SELECTED TRIBUTARIES.

J.R. SCHUBEL

LOUISIANA STATE UNIV. SYSTEMS COASTAL STUDIES INSTITUTE

8.0008 EFFECTS OF HURRICANE CAMILLE ON THE LANDSCAPE OF THE BRETON-CHANDELEUR ISLAND CHAIN AND THE EASTERN PORTION OF THE LOWER MISSISSIPPI DELTA.

ING HURRICANES A PILOT STUDY FOR DADE COUNTY, FLORIDA.

UNKNOWN

8.0128 INVESTIGATION OF SHORELINE SARGENT BEACH, TEXAS,

OCEAN DATA SYSTEMS INC.

8.0105 EXTENDING THE COMPUTERIZED TYPHOON/TROPICAL STORM PREDICTION PROGRAM (TYPHOON 72) TOWARD SEVEN DAYS.

UNKNOWN

PENN. STATE UNIVERSITY
SCHOOL OF EARTH SCIENCES

8.0125 NUMERICAL STUDIES OF RAINBAND CIRCULATIONS IN TROPICAL CYCLONES.

R. A. ANTHER

PRINCETON UNIVERSITY
GRADUATE SCHOOL

8.0120 MICRO AND MESOSCALE GEOPHYSICAL FLUID DYNAMICS.

Y. KURIHARA

PURDUE UNIVERSITY
SCHOOL OF CIVIL ENGINEERING

8.0102 PROBABILISTIC ANALYSIS OF ELASTO-PLASTIC STRUCTURES.

T. L. PAEZ

SMITHSONIAN INSTITUTION

8.0003 EFFECTS OF TROPICAL STORM AGNES ON THE CHESAPEAKE BAY.

D. CORRELL

STATE DIV. OF MINES & GEOLOGY

8.0018 URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV).

J. T. ALFORD

STATE RES. & DEV. CENTER

8.0011 GRANT TO DESIGN A REBUILDING PLAN FOR GULFPORT, MISSISSIPPI, TO RESTORE THE DAMAGE OF HURRICANE CAMILLE. VOLUMES I, II, & III (ABBREV).

UNKNOWN

8.0012 GRANT TO DESIGN A REBUILDING PLAN FOR GULFPORT, MISSISSIPPI, TO RESTORE THE DAMAGE OF HURRICANE CAMILLE. VOLUMES IV & V (ABBREV).

UNKNOWN

T R W INCORPORATED

8.0054 TROPICAL CYCLONE ENERGY TRANSFER.

P. DERGARABEDIAN

8.0055 TROPICAL CYCLONES.

EE. FEARNS

U R S SYSTEMS CORPORATION

8.0056 THE EFFECTS OF HURRICANE ON INDUSTRY, PUBLIC UTILITIES, AND PUBLIC OPERATIONS.

U.S. AIR FORCE
AIR WEATHER SERVICE

8.0029 WATER WARNINGS AND FORECASTS.

U.S. AIR FORCE
ENVIRON. TECH. APPL. CENTER

8.0071 A SURVEY OF AVAILABILITY OF HURRICANE/TYPHOON PACKAGES AND DATA.

U.S. ARMY
COASTAL ENGINEERING RESEARCH CENTER

8.0019 CONCRETE BLOCK REVENUE BENEDECT, MARYLAND.

8.0072 STORM SURGE ON THE OPEN COAST - EXPERIMENTALS AND SIMPLIFIED PREDICTIONS

8.0073 LONG-PERIOD WAVES AND SURGES

U.S. ARMY
ENGINEER DISTRICT

8.0025 BAL. HARBOUR, FLORIDA PARK RESTORATION, BEACH EROSION CONTROL, HURRICANE PROTECTION PROJECT, DADE COUNTY, FLORIDA.

8.0028 JEKYLL ISLAND, GEORGIA, BEACH EROSION CONTROL AND HURRICANE PROTECTION

8.0030 GRAND ISLE, LOUISIANA, AND VICTIM RICHIE PROTECTION ASSOCIATED WITH BAYOU LAFOURCHE - LOUISIANA

8.0031 NEW ORLEANS TO VENICE, LOUISIANA - HURRICANE PROTECTION.

8.0032 LAKE PONTCHARTRAIN, LOUISIANA - VICINITY - HURRICANE PROTECTION PROJECT

8.0033 MORGAN CITY, LOUISIANA, AND VICINITY (FRANKLIN AND VICINITY AREA).

8.0050 VIRGINIA BEACH, VIRGINIA - BEACH EROSION CONTROL AND HURRICANE PROTECTION.

UNKNOWN

U.S. ARMY
ESTUARIES DIVISION

8.0013 TEXAS COAST HURRICANE SURGE MODEL STUDIES.

N.J. BROGDON

U.S. ARMY
NEW ENGLAND DIVISION

8.0034 HURRICANE PROTECTION PROJECT, STRATFORD, CONNECTICUT.

UNKNOWN

8.0035 OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, MASSACHUSETTS.

UNKNOWN

8.0036 OPERATION AND MAINTENANCE OF NEW BEDFORD HURRICANE BARRIER, NEW BEDFORD, MASSACHUSETTS.

UNKNOWN

8.0037 NEW LONDON HURRICANE PROTECTION PROJECT, NEW LONDON, CONNECTICUT.

UNKNOWN

U.S. ARMY
WATERWAYS EXPERIMENT STATION

8.0014 SURVEY OF GULF COAST STRUCTURAL DAMAGE RESULTING FROM HURRICANE CAMILLE, AUGUST 1969.

M.E. CRISPILL

8.0038 GALVESTON BAY HURRICANE SURGE - REPORT 2. EFFECTS OF PROPOSED BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV).

W.H. BOBB

8.0039 GALVESTON BAY HURRICANE SURGE - REPORT 3 - EFFECTS OF BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV).

W.H. BOBB

8.0040 GALVESTON BAY HURRICANE SURGE STUDY - BARRIERS ON HURRICANE SURGE HEIGHTS - HYDRAULIC MODEL INVESTIGATION.

N.J. BROGDON

8.0041 WAVE AND SURGE CONDITIONS AFTER PROPOSED EXPANSION OF MONTEREY HARBOR, MONTEREY, CALIFORNIA - HYDRAULIC MODEL INVESTIGATION.

C.E. CHATHAM

8.0042 WAVE AND SURGE ACTION, MONTEREY HARBOR, MONTEREY, CALIFORNIA - MODEL INVESTIGATION.

E.P. FORTSON

8.0043 DISCHARGE CHARACTERISTICS OF HURRICANE BARRIERS, WAREHAM-MARION, MASSACHUSETTS.

SETT BAY, RHODE ISLAND - HYDRAULIC MODEL INVESTIGATION.

G.A. PICKERING

8.0045 GALVESTON BAY HURRICANE SURGE - REPORT 1 - EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS (ABBREV).

R.A. SAGER

8.0046 GALVESTON BAY HURRICANE SURGE - REPORT (2) EFFECTS OF PROPOSED BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV).

R.A. SAGER

8.0047 PROTECTION OF NARRAGANSETT BAY FROM HURRICANE SURGES.

H.B. SIMMONS

8.0048 EFFECTS ON LAKE PONTCHARTRAIN, LA., OF HURRICANE SURGE CONTROL STRUCTURES AND MISSISSIPPI RIVER-GULF OUTLET CHANNEL.

J.C. TALLANT

8.0119 JAMAICA BAY HURRICANE BARRIER STUDY NEW YORK.

T.C. HILL

U.S. COASTAL BEND REG. COMM.

8.0015 HURRICANE CELIA REDEVELOPMENT.

UNKNOWN

U.S. DEPT. OF COMMERCE
BUILDING RESEARCH DIV.

8.0074 HURRICANE CAMILLE - AUGUST 1969.

R.D. DIKKERS

U.S. DEPT. OF COMMERCE
CENTER FOR BUILDING TECHNOLOGY

8.0077 DESIGN, SITING, AND CONSTRUCTION OF LOW-COST HOUSING AND COMMUNITY BUILDINGS TO BETTER WITHSTAND EARTHQUAKES AND WINDSTORMS.

W.F. REPS

U.S. DEPT. OF COMMERCE
ENVIRON. RESEARCH LABORATORIES

8.0057 HURRICANE MODIFICATION.

R.C. GENTRY

8.0058 TROPICAL METEOROLOGIC PROBLEMS.

R.C. GENTRY

8.0060 STORM SURGE RESEARCH.

F. OSTAPOFF

8.0061 HURRICANE RESEARCH MODELING.

S.L. ROSENTHAL

8.0062 HURRICANE MODELING.

S.L. ROSENTHAL

8.0063 HURRICANE-TYPHOON DYNAMICS.

M. SCHERER

8.0064 HURRICANE-OCEAN INTERACTION.

U.S. DEPT. OF COMMERCE
NATIONAL WEATHER SERVICE

- 8.0112 JOINT PROBABILITY METHOD OF TIDE
FREQUENCY ANALYSIS APPLIED TO ATLANTIC CITY
AND LONG BEACH ISLAND, NEW JERSEY.
P.A. MYERS

U.S. DEPT. OF COMMERCE
NATL. BUREAU OF STANDARDS

- 8.0076 HURRICANE EFFECTS ON PORT FACILITIES.
R.D. MARSHALL
8.0078 WIND AND SURGE DAMAGE DUE TO HUR-
RICANE CAMILLE.
H.C. THOM

U.S. DEPT. OF COMMERCE
NATL. CLIMATIC CENTER

- 8.0122 ATLANTIC TROPICAL CYCLONE STRIKE
PROBABILITIES (FOR SELECTED STATIONS AND THE
MONTH OF SEPTEMBER).
H.L. CRUTCHER
8.0123 PRELIMINARY CLIMATIC DATA REPORT HUR-
RICANE AGNES JUNE 14-23, 1972.
R.M. DEANGELIS

U.S. DEPT. OF COMMERCE
NATL. ENVIRON. SATELLITE SERV.

- 8.0075 A TECHNIQUE FOR THE ANALYSIS AND
FORECASTING OF TROPICAL CYCLONE INTENSITIES
FROM SATELLITE PICTURES.
V.F. DVORAK

U.S. DEPT. OF COMMERCE
NATL. HURRICANE CENTER

- 8.0084 ATLANTIC TROPICAL SYSTEMS OF 1972.
N.L. FRANK
8.0087 OBJECTIVE ANALYSIS OF SEA SURFACE TEM-
PERATURES (SST).
B.R. JARVINEN
8.0088 CIRCULATION FEATURES OF TROPICAL
CYCLONES.
B.R. JARVINEN
8.0089 PREDICTION OF HURRICANE DEVELOPMENT
AND MOVEMENT WITH A BAROCLINIC MODEL.
B.I. MILLER
8.0090 GRAPHICAL DISPLAY OF HURRICANE
FORECASTS.
C.J. NAUMANN
8.0091 STATISTICAL-DYNAMICAL PREDICTION OF
HURRICANE TRACKS.
C.J. NEUMANN
8.0092 ERROR ANALYSIS OF HURRICANE FORECASTS.
J.M. PELISSIER
8.0093 BAROTROPIC PREDICTION OF HURRICANE
TRACKS.
A.C. PIKE

U.S. DEPT. OF COMMERCE
NATL. HURRICANE RES. LAB.

- 8.0085 HURRICANE DEBBIE MODIFICA-
MENTS, AUGUST 1969.
8.0095 PROJECT STORMFURY ANNUAL
U.S. DEPT. OF COMMERCE
NATL. OCEANIC & ATMOS. AD.
8.0004 FEDERAL PLAN FOR METEORO-
LOGICAL VICES & SUPPORTING RESEARCH
1974.
8.0020 NATIONAL HURRICANE OPERATI-
ONAL PLAN.
8.0021 NATIONAL HURRICANE OPERA-
TIONAL PLAN, 1974.
8.0022 FINAL REPORT OF THE DISAS-
TER TEAM ON THE EVENTS OF AGNES.
8.0023 THE HOMEPORT STORY - AN IM-
MEDIATELY READY FOR A HURRICANE.
8.0106 BENEFITS OF ENVIRONMENTAL
IMPROVEMENT IN THE EASTERN GULF OF MEXICO.
8.0107 HURRICANE MODIFICATION RES-
ULTS OF PROJECT STORMFURY).

U.S. DEPT. OF COMMERCE
NATL. WEATHER SERVICE

- 8.0005 ATLANTIC HURRICANE SEASON
SUMMARY.
8.0016 MEMORABLE HURRICANES OF
THE UNITED STATES SINCE 1973.
8.0086 COMPUTER METHODS APPLIED
TO THE ANALYSIS OF TROPICAL STORM AND HUR-
RICANE METEOROLOGY.
8.0097 GIANT WAVES HIT HAWAII.
8.0127 SOUTH CAROLINA HURRICANE
DESCRIPTIVE LISTING OF TROPICAL STORMS
THAT HAVE AFFECTED SOUTH CAROLINA.
8.0129 OBJECTIVE ANALYSIS OF THE
TEMPERATURE.
8.0130 A DECISION PROCEDURE FOR
PREDICTING THE LANDFALL OF HURRICANES.
8.0131 THE DECISION PROCESS IN
HURRICANE FORECASTING.

U.S. DEPT. OF COMMERCE
OFF. OF HYDROLOGY

8.0108 VISUAL, IR, AND DATA COLLECTION CAPABILITIES OF THE GOES SATELLITE.

A.F. FLANDERS

U.S. DEPT. OF COMMERCE
TECHNIQUES DEVELOPMENT LAB.

8.0109 TROPICAL STORM SURGE FORECASTING.

C.P. JELESNIANSKI

8.0110 SPECIAL PROGRAM TO LIST AMPLITUDES OF SURGES FROM HURRICANES - 1. LANDFALL STORMS.

C.P. JELESNIANSKI

8.0111 SPECIAL PROGRAM TO LIST AMPLITUDES OF SURGES FROM HURRICANES - PART 2. GENERAL TRACK AND VARIANT STORM CONDITIONS.

C.P. JELESNIANSKI

8.0113 MARINE ENVIRONMENTAL PREDICTION.

N.A. PORE

8.0114 SUMMARY OF SELECTED REFERENCE MATERIAL ON THE OCEANOGRAPHIC PHENOMENA OF TIDES, STORM SURGES, WAVES, AND BREAKERS.

N.A. PORE

8.0115 MARINE CONDITIONS AND AUTOMATED FORECASTS FOR THE ATLANTIC COASTAL STORM OF FEBRUARY 18-20, 1972.

N.A. PORE

8.0116 FORECASTING EXTRATROPICAL STORM SURGES FOR THE NORTHEAST COAST OF THE UNITED STATES.

N.A. PORE

U.S. DEPT. OF COMMERCE
WEATHER MODIFICATION PRG. OFF.

8.0059 A PRELIMINARY VIEW OF STORM SURGES BEFORE AND AFTER STORM MODIFICATIONS.

C.P. JELESNIANSKI

U.S. DEPT. OF HOU. & URB. DEV.
FED. INSURANCE ADMINISTRATION

8.0079 REPORT ON EARTHQUAKE INSURANCE TO CONGRESS OF UNITED STATES - PURSUANT TO SECTION FIVE OF SOUTHEAST HURRICANE DISASTER RELIEF ACT 1965.

UNKNOWN

U.S. DEPT. OF THE INTERIOR
GEOLOGICAL SURVEY

8.0027 ESTUARINE HYDROLOGY OF TAMPA BAY.

C.R. GOODWIN

U.S. EXEC. OFFICE OF THE PRES.
OFF. OF EMERGENCY PREPAREDNESS

8.0001 THE FEDERAL RESPONSE TO TROPICAL STORM AGNES. A REPORT TO THE SENATE COMMITTEE ON PUBLIC WORKS, SUBCOMMITTEE ON DISASTER RELIEF.

UNKNOWN

U.S. NATL. AERO. & SPACE ADM.
GODDARD SPACE FLIGHT CENTER

8.0104 MICROWAVE METEOROLOGY.

J.L. KING

U.S. NATL. AERO. & SPACE ADM.
JOHN F. KENNEDY SPACE CENTER

8.0083 HURRICANE PREPAREDNESS AND CONTROL PLAN.

UNKNOWN

U.S. NAVY
ENVIRON. PRED. RES. FACILITY

8.0053 TROPICAL CYCLONE MOVEMENT FORECASTS BASED ON OBSERVATIONS FROM SATELLITES.

R.W. FETT

U.S. NAVY
POSTGRADUATE SCHOOL

8.0052 FURTHER VERIFICATIONS OF AND EXPERIMENTS TO IMPROVE THE MODIFIED HATRACK SCHEME FOR FORECASTING THE MOTION OF TROPICAL CYCLONES.

S.G. COLGAN

U.S. NAVY
WEATHER RESEARCH FACILITY

8.0136 STORM SURGE FORECASTING.

J.W. NICKERSON

U.S. NAVY
WEATHER SERVICE COMMAND

8.0080 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME I - 24 HOUR MOVEMENT.

H.L. CRUTCHER

8.0081 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME II - 48 HOUR MOVEMENT.

H.L. CRUTCHER

8.0082 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME III - 72 HOUR MOVEMENT.

H.L. CRUTCHER

UNIV. OF CALIFORNIA
SCHOOL OF ENGINEERING

HURRICANES

UNIV. OF CHICAGO SCHOOL OF PHYSICAL SCIENCES

- 8.0100 PROPOSED CHARACTERIZATION OF TORNADOES AND HURRICANES BY AREA AND INTENSITY,
T.T. FUJITA

UNIV. OF DELAWARE SCHOOL OF ARTS

- 8.0002 COASTAL STORM DAMAGE WITH SPECIAL REFERENCE TO THE DELMARVA REGION OF DELAWARE, MARYLAND, VIRGINIA,
F.J. SWAYE

UNIV. OF DELAWARE SCHOOL OF MARINE SCIENCE

- 8.0070 STATISTICAL PREDICTION OF HURRICANE STORM SURGE - SOME MATHEMATICAL CONCEPTS RELATED TO STOCHASTIC SPECTRUM ANALYSIS (ABBREV).
C.Y. YANG

UNIV. OF FLORIDA SCHOOL OF ENGINEERING

- 8.0024 KENNEDY SPACE CENTER OCEAN BEACH EROSION - FLORIDA,
A.J. MEHTA

UNIV. OF HAWAII SCHOOL OF ARTS

- 8.0098 USE OF SATELLITE DATA IN STUDIES OF TROPICAL DISTURBANCES,
T. MURAKAMI
8.0099 THEORETICAL ANALYSIS OF LARGE-SCALE TROPICAL DISTURBANCES,
T. MURAKAMI

UNIV. OF ILLINOIS SCHOOL OF ENGINEERING

- 8.0101 PROBABILISTIC MODELING OF EXTREME LOADS,
Y.K. WEN

UNIV. OF MIAMI SCHOOL OF MARINE SCIENCE

- 8.0006 APPLICATION OF ECONOMIC ANALYSES TO HURRICANE WARNINGS TO RESIDENTIAL AND RETAIL ACTIVITIES IN THE U. S. GULF OF MEXICO COASTAL REGION,
L.G. ANDERSON

UNIV. OF PITTSBURGH GRADUATE SCHOOL

- 8.0124 ALTERNATIVE ADJUSTMENTS TO HAZARDS.

UNIV. OF RHODE ISLAND SCHOOL OF ENGINEERING

- 8.0126 ANALYTICAL PHYSICAL MODEL.

UNIV. OF WISCONSIN GRADUATE SCHOOL

- 8.0137 ENERGY, MASS AND ANGULAR BUDGETS OF EXTRATROPICAL CYCLONES,
D.

UNIV. OF WISCONSIN SCHOOL OF LETTERS

- 8.0138 NUMERICAL STUDIES IN THE CLIMATE AND STORM SURGES IN LAKE ONTARIO.

- UNKNOWN INST. OR INDIV. GRADUATE SCHOOL
8.0007 THE NATURE AND EXTENT OF STORM DAMAGE CAUSED BY HURRICANE CAMILLE

- VIRGINIA INST. OF MARINE SCIENCE
8.0134 FORECASTING STORM-INDUCED CHANGES ALONG VIRGINIA'S OCEAN COAST

- 8.0135 OPERATION AGNES.

WILLIAMS COLLEGE GRADUATE SCHOOL

- 8.0118 PROFILE OF A STORM - WIND, WAVE EROSION ON THE SOUTHEASTERN SHORE OF MICHIGAN.

LAND SLIDES

CALIF. INST. OF TECHNOLOGY GRADUATE SCHOOL

- 9.0004 GENERAL REVIEW OF THE SEISMICITY TO SELECTED U.S. NAVY INSTALLATIONS

COLUMBIA UNIVERSITY SCHOOL OF ARTS

GLENDDORA CITY GOVERNMENT

ENGINEERING GEOLOGIC REPORT OF
GENERAL PLAN STUDY FOR THE CITY OF GLEN-
DORA, CALIFORNIA,

F.B. LEIGHTON

HAMEL GEOTECHNICAL CONSULTANTS

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RDY, U.S. Dept. of Agriculture, Interntn. For. & Rg. Sta.

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SCHE, U.S. Dept. of Agriculture, Interntn. For. & Rg. Sta.

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OW, Auburn University, Center For Urban & Regional Development

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ULE, U.S. Dept. of the Interior, Geological Survey

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7 HYDROLOGY OF STREAMS IN ST. LOUIS METROPOLITAN AREA

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6.0332 COMPREHENSIVE PLAN - REPORT C, IMPL-
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UNKNOWN, State Water Resour. Board

6.0350 APPRAISAL OF THE WATER AND RELATED
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UNKNOWN, Clatsop Tillamook Intergov.

6.0352 FLOOD PLAIN ANALYSIS AND DISASTER STU-
DY, CLATSOP AND TILLAMOOK COUNTIES,
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UNKNOWN, Lincoln Co. Planning Dept.

6.0354 DEVELOPMENT IN FLOOD-PRONE AREAS OF
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UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0357 THE EFFECT OF GROUND-WATER CONDI-
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UNKNOWN, U.S. Army, Engineer District

6.0358 FLOOD-PROOFING REGULATIONS

UNKNOWN, State Planning Board

6.0362 FLOOD CONTROL STUDY OF RIO GRANDE DE
MANATI, MANATI AND BARCELONETA, PUERTO
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UNKNOWN, State Planning & Grants Div.

6.0363 MYRTLE BEACH, S.C. - COMPREHENSIVE
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UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0364 FLOOD PLAIN INUNDATION

UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0365 FLOOD FREQUENCY OF SMALL AREAS -
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UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0366 INVESTIGATION AND ANALYSIS OF FLOOD
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UNKNOWN, State Planning Commission

6.0369 ZONING ORDINANCE, HUNTINGDON, TEN-
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UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0377 URBAN HYDROLOGY STUDY - SAN ANTONIO,
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UNKNOWN, Texas A & M University System, Water
Resources Institute

6.0379 WATER FOR TEXAS - URBAN WATER
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UNKNOWN, U.S. Coastal Bend Reg. Comm.

6.0380 OSO CREEK TECHNICAL ASSISTANCE STUDY
- PRELIMINARY STUDY ON THE PROBLEMS AND
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UNKNOWN, Texoma Regional Planning Comm.

6.0381 SOIL AND WATER CONSERVATION NEEDS IN-
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UNKNOWN, U.S. Army, Corps of Engineers

6.0405 FLOOD HAZARD INFORMATION - BUFFALO
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DISASTER CONDITIONS

UNKNOWN, U.S. Dept. of the Interior, Geological Survey

6.0415 STUDY OF FLOOD HYDROGRAPHS FOR
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A.O. WAANANEN, State Dept. of Transportation

6.0043 FLOODS FROM SMALL DRAINAGE AREAS IN
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A.O. WAANANEN, U.S. Dept. of the Interior, Geological Sur-
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6.0176 FLOODS FROM SMALL DRAINAGE AREAS -
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6.0306 SOCIO-ECONOMIC IMPLICATIONS OF ALTER-
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A. WAIRY, Bullitt Co. Planning Comm

6.0286 FLOOD PLAN FOR BULLITT COUNTY, KEN-
TUCKY

L.A. WAITE, U.S. Dept. of the Interior, Geological Survey

6.0020 FLOOD OF JULY 17, 1972 IN GALLUP, NEW
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W.R. WALKER, Virginia Polytechnic Institute, Graduate
School

6.0013 EVALUATION OF FLOOD INSURANCE IN A
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W.R. WALKER, Virginia Polytechnic Institute, Water
Resources Research Ctr

6.0398 FLOOD DAMAGE ABATEMENT: FEDERAL
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W.R. WALKER, Virginia Polytechnic Institute, Water
Resources Research Ctr

6.0399 FLOOD DAMAGE ABATEMENT STUDY FOR
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J.R. WALLACE, Georgia Inst. of Technology, Environmental
Resources Center

6.0242 THE EFFECTS OF LAND USE CHANGE ON
THE HYDROLOGY OF AN URBAN WATERSHED

R. WANG, Univ. of Hawaii, Water Resources Research Ctr.

6.0078 INSTANTANEOUS UNIT HYDROGRAPH ANAL-
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B.E. WASSON, U.S. Dept. of the Interior, Geological Survey

6.0310 CITY OF JACKSON, MISSISSIPPI, WATER
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E.E. WEBBER, U.S. Dept. of the Interior, Geological Survey

6.0349 FLOOD HYDROLOGY OF SMALL DRAINAGE
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WATER RESOURCES PLANNING CENTER
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D.M. WELLS, Texas Technological U
Resources Center

6.0387 VARIATION OF URBAN RUNOFF
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J.D. WELLS, U.S. Dept. of the Interior, Geol

6.0188 HAMILTON 2 DEGREE

B.H. WHETSTONE, U.S. Dept. of the Interior,
vey

6.0222 INVESTIGATION AND ANALYSIS
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W. WHIPPLE, Rutgers the State University,
Research Inst.

6.0324 ECONOMIC BASIS FOR WATER
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H.C. WIDBEN, U.S. Dept. of the Interior, Geol

6.0371 INVESTIGATION OF THE MAG-
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D. WILKES, Univ. of Massachusetts, Man &
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6.0293 LEGAL ISSUES ON ECONOMIC
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D. WILKES, Univ. of Massachusetts, W
Research Ctr.

6.0294 LEGAL FACTORS IN ECONOMIC
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G.E. WILLEKE, Georgia Inst. of Technology
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6.0243 A PROGRAM FOR METROPOL
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G.L. WILLIAMS, Lockwood Andrews & Newn

6.0385 PALACIOS COMPREHENSIVE PL
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P. WILLIAMS, U.S. Dept. of Commerce, Nat
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6.0391 FLASH FLOOD FORECASTING A
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J.A. WILSON, Iowa State University, W
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6.0089 PLANT SPECIES AS WILDLIFE
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6.0065 FLOOD FREQUENCY IN SMALL
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- K.V. WILSON, U.S. Dept. of the Interior, Geological Survey
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6.0413 THE USE OF DETAILED SOILS INFORMATION FOR DELINEATING AND REGULATING FLOOD PLAINS - LEGAL AND ADMINISTRATIVE CONSIDERATIONS
- V. YEVJEVICH, Colorado State University, School of Engineering
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7.0018 STUDY OF THE FEATURES AND ENERGY BUDGETS OF NORTHEASTERN COLORADO HAIL STORMS - ALSO, WISCONSIN
- L. BOONE, Univ. of Nebraska, U.S.D.A. Nat. Resour. Ec. Div.
7.0005 ECONOMIC AND INSTITUTIONAL CONSIDERATIONS OF SUPPRESSING HAIL
- L.M. HOONE, U.S. Dept. of Agriculture, Economic & Stat. Analysis Div.
7.0001 ESTIMATING CROP LOSSES DUE TO HAIL. STATISTICAL SUPPLEMENT TO AGRICULTURAL ECONOMIC REPORT NO. 267
- L.M. BOONE, U.S. Dept. of Agriculture, Economic Research Service
7.0007 ECONOMIC AND INSTITUTIONAL CONSIDERATIONS OF SUPPRESSING HAIL
- S.A. CHANGNON, State Water Survey
7.0008 STUDIES OF HAIL DATA IN 1970-72 - ILLINOIS
- J.W. FIROR, Natl. Center For Atmosph. Res.
7.0010 NATIONAL HAIL RESEARCH EXPERIMENT SUPPORT FOR 1973 - COLORADO
- L.D. GRANT, Colorado State University, School of Engineering
7.0013 EXTENDED AREA EFFECTS FROM LOCAL WEATHER MODIFICATION
- L.A. JONES, U.S. Dept. of Agriculture, Farm Production Economics Div.
7.0002 MEASUREMENT AND ANALYSIS OF FARM RISKS, LOSSES, AND INSURANCE
- G.M. MORGAN, Univ. of Illinois, School of Liberal Arts
7.0015 DESIGN OF HAIL SUPPRESSION EXPERIMENT IN ILLINOIS

- C.M. SAKAMOTO, U.S. Dept. of Commerce, Natl. Weather Service
7.0016 THUNDERSTORMS AND HAIL DAYS PROBABILITIES IN NEVADA
- P.T. SCHICKEDANZ, State Water Survey
7.0003 A STUDY OF CROP HAIL INSURANCE RECORDS FOR NORTHEASTERN COLORADO WITH RESPECT TO THE DESIGN OF THE NATIONAL HAIL EXPERIMENT
- UNKNOWN, Natl. Center For Atmosph. Res.
7.0011 THE NATIONAL HAIL RESEARCH EXPERIMENT SUMMER 1973 SUMMARY REPORT
- UNKNOWN, U.S. Natl. Science Foundation
7.0014 NATIONAL HAIL RESEARCH EXPERIMENT - COLORADO, NEBRASKA, WYOMING
- J.J. VORST, Purdue University, Agricultural Experiment Sta.
7.0004 SOYBEAN PHYSIOLOGY AND MANAGEMENT
- H. WEICKMANN, U.S. Dept. of Commerce, Environ. Research Laboratories
7.0012 HAIL AND LIGHTNING - COLORADO
- J.A. YOUNG, Battelle Memorial Institute
7.0017 TRACER STUDIES IN THE NATIONAL HAIL RESEARCH EXPERIMENT (NHRE)

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- F.M. ABDELAAL, Univ. of California, School of Engineering
8.0051 PRELIMINARY REPORT ON AN ANALYSIS OF PROJECT II DATA (WAVE FORCES ON A PILE), HURRICANE CARLA, GULF OF MEXICO
- J.T. ALFORE, State Div. of Mines & Geology
8.0018 URBAN GEOLOGY PLAN FOR CALIFORNIA - THE NATURE, MAGNITUDE, & COSTS OF GEOLOGIC HAZARDS & RECOMMENDATIONS FOR THEIR MITIGATION (ABBREV)
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8.0006 APPLICATION OF ECONOMIC ANALYSES TO HURRICANE WARNINGS TO RESIDENTIAL AND RETAIL ACTIVITIES IN THE U. S. GULF OF MEXICO COASTAL REGION
- R.A. ANTIES, Penn. State University, School of Earth Sciences
8.0125 NUMERICAL STUDIES OF RAINBAND CIRCULATIONS IN TROPICAL CYCLONES
- D.G. AREY, Univ. of Pittsburgh, Graduate School
8.0124 ALTERNATIVE ADJUSTMENTS TO NATURAL HAZARDS
- T.W. III HORN, Gulf Univ. Res. Consortium
8.0049 THE USE OF GRASSES FOR DUNE STABILIZATION ALONG THE GULF COAST WITH INITIAL EMPHASIS ON THE TEXAS COAST

- W.H. BOBB, U.S. Army, Waterways Experiment Station
8.0039 GALVESTON BAY HURRICANE SURGE - REPORT 3 - EFFECTS OF BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV)
- B.R. BODINE, U.S. Army, Coastal Engin. Res. Center
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- J. BOTTOMS, U.S. Dept. of Commerce, Natl. Weather Service
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8.0013 TEXAS COAST HURRICANE SURGE MODEL STUDIES
- N.J. BROGDON, U.S. Army, Waterways Experiment Station
8.0040 GALVESTON BAY HURRICANE SURGE STUDY - BARRIERS ON HURRICANE SURGE HEIGHTS - HYDRAULIC MODEL INVESTIGATION
- G.F. CARRIER, Harvard University, School of Arts
8.0117 NAVY ENVIRONMENT - FLUID MECHANICS RESEARCH II
- C.E. CHATHAM, U.S. Army, Waterways Experiment Station
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- S.G. COLGAN, U.S. Navy, Postgraduate School
8.0052 FURTHER VERIFICATIONS OF AND EXPERIMENTS TO IMPROVE THE MODIFIED HATRACK SCHEME FOR FORECASTING THE MOTION OF TROPICAL CYCLONES
- D. CORRELL, Smithsonian Institution
8.0003 EFFECTS OF TROPICAL STORM AGNES ON THE CHESAPEAKE BAY
- M.E. CRISWELL, U.S. Army, Waterways Experiment Station
8.0014 SURVEY OF GULF COAST STRUCTURAL DAMAGE RESULTING FROM HURRICANE CAMILLE, AUGUST 1969
- H.L. CRUTCHER, U.S. Navy, Weather Service Command
8.0080 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME I - 24 HOUR MOVEMENT
- H.L. CRUTCHER, U.S. Navy, Weather Service Command
8.0081 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME II - 48 HOUR MOVEMENT
- H.L. CRUTCHER, U.S. Navy, Weather Service Command
8.0082 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES - VOLUME III - 72 HOUR MOVEMENT
- H.L. CRUTCHER, U.S. Dept. of Commerce, Natl. Climatic Center
8.0122 ATLANTIC TROPICAL CYCLONE STRIKE PROBABILITIES (FOR SELECTED STATIONS AND THE MONTH OF SEPTEMBER)

- P. DERGARABEDIAN, T.R.W. Incorporated
8.0054 TROPICAL CYCLONE ENERGY TRANSFER
- R.D. DIKKERS, U.S. Dept. of Commerce, Building Research Div.
8.0074 HURRICANE CAMILLE - AUGUST 1969
- V.F. DVORAK, U.S. Dept. of Commerce, Natl. Environ. Satellite Serv.
8.0075 A TECHNIQUE FOR THE ANALYSIS AND FORECASTING OF TROPICAL CYCLONE INTENSITIES FROM SATELLITE PICTURES
- C.C. EASTERBROOK, Calspan Corporation
8.0121 CASE STUDIES OF COASTAL CONVECTIVE STORMS AS OBSERVED BY DOPPLER RADAR
- M.A. ESTOQUE, Univ. of Miami, School of Marine Science
8.0096 HURRICANE MODIFICATION BY CLOUD SEEDING
- F.E. FENDELL, T.R.W. Incorporated
8.0055 TROPICAL CYCLONES
- R.W. FETT, U.S. Navy, Environ. Pred. Res. Facility
8.0053 TROPICAL CYCLONE MOVEMENT FORECASTS BASED ON OBSERVATIONS FROM SATELLITES
- A.F. FLANDERS, U.S. Dept. of Commerce, Off. of Hydrology
8.0108 VISUAL, IR, AND DATA COLLECTION CAPABILITIES OF THE GOES SATELLITE
- E.P. FORTSON, U.S. Army, Waterways Experiment Station
8.0042 WAVE AND SURGE ACTION, MONTEREY HARBOR, MONTEREY, CALIFORNIA - MODEL INVESTIGATION
- W.T. FOX, Williams College, Graduate School
8.0118 PROFILE OF A STORM - WIND, WAVES AND EROSION ON THE SOUTHEASTERN SHORE OF LAKE MICHIGAN
- N.L. FRANK, U.S. Dept. of Commerce, Natl. Hurricane Center
8.0084 ATLANTIC TROPICAL SYSTEMS OF 1972
- T.T. FUJITA, Univ. of Chicago, School of Physical Sciences
8.0100 PROPOSED CHARACTERIZATION OF TORNADOES AND HURRICANES BY AREA AND INTENSITY
- R.C. GENTRY, U.S. Dept. of Commerce, Environ. Research Laboratories
8.0057 HURRICANE MODIFICATION
- R.C. GENTRY, U.S. Dept. of Commerce, Environ. Research Laboratories
8.0058 TROPICAL METEOROLOGIC PROBLEMS
- R.C. GENTRY, U.S. Dept. of Commerce, Natl. Hurricane Res. Lab.
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- C.R. GOODWIN, U.S. Dept. of the Interior, Geological Survey
8.0027 ESTUARINE HYDROLOGY OF TAMPA BAY

- W.M. GRAY, Colorado State University, School of Engineering
8.0066 INVESTIGATION OF SATELLITE OBSERVED
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FLOW FEATURES
- W.M. GRAY, Colorado State University, School of Engineering
8.0067 STUDIES OF CUMULUS HEATING AND THE
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- J.V. HALL, U.S. Army, Coastal Engin. Res. Center
8.0019 CONCRETE BLOCK REVETMENT NEAR
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- W. HARRISON, Virginia Inst. of Marine Sci.
8.0134 FORECASTING STORM-INDUCED BEACH
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- T.C. HILL, U.S. Army, Waterways Experiment Station
8.0119 JAMAICA BAY HURRICANE BARRIER STUDY
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- J.R. HOPE, U.S. Dept. of Commerce, Natl. Weather Service
8.0086 COMPUTER METHODS APPLIED TO ATLANTIC
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- B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Hurricane
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8.0087 OBJECTIVE ANALYSIS OF SEA SURFACE TEMPERATURES (SST)
- B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Hurricane
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8.0088 CIRCULATION FEATURES OF TROPICAL
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- B.R. JARVINEN, U.S. Dept. of Commerce, Natl. Weather Service
8.0129 OBJECTIVE ANALYSIS OF THE SEA SURFACE
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- C.P. JELESNIANSKI, U.S. Dept. of Commerce, Weather
Modification Prg. Off.
8.0059 A PRELIMINARY VIEW OF STORM SURGES
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- C.P. JELESNIANSKI, U.S. Dept. of Commerce, Techniques
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8.0109 TROPICAL STORM SURGE FORECASTING
- C.P. JELESNIANSKI, U.S. Dept. of Commerce, Techniques
Development Lab.
8.0110 SPECIAL PROGRAM TO LIST AMPLITUDES OF
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- C.P. JELESNIANSKI, U.S. Dept. of Commerce, Techniques
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8.0137 ENERGY, MASS AND ANGULAR MOMENTUM
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- J.L. KING, U.S. Natl. Aero. & Space Adm., Goddard Space
Flight Center
8.0104 MICROWAVE METEOROLOGY
- A. KUO, Virginia Inst. of Marine Sci.
8.0135 OPERATION AGNES
- Y. KURIHARA, Princeton University, Graduate School
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- R.D. MARSHALL, U.S. Dept. of Commerce, Natl. Bureau of
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- E.C. MCNAIR, U.S. Army, Waterways Experiment Station
8.0043 DISCHARGE CHARACTERISTICS OF HURRICANE
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- A.R. MEALS, U.S. Air Force, Environ. Tech. Appl. Center
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- A.J. MEHTA, Univ. of Florida, School of Engineering
8.0024 KENNEDY SPACE CENTER OCEAN BEACH
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- B.I. MILLER, U.S. Dept. of Commerce, Natl. Hurricane
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8.0089 PREDICTION OF HURRICANE DEVELOPMENT
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- P. MONTJOY, Coast Code Administration
8.0010 REGIONAL CODE ENFORCEMENT - HANCOCK,
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- T. MURAKAMI, Univ. of Hawaii, School of Arts
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- T. MURAKAMI, Univ. of Hawaii, School of Arts
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- V.A. MYERS, U.S. Dept. of Commerce, National Weather
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- C.J. NAUMANN, U.S. Dept. of Commerce, Natl. Hurricane
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8.0090 GRAPHICAL DISPLAY OF HURRICANE
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- C.J. NEUMANN, U.S. Dept. of Commerce, Natl. Hurricane
Center
8.0091 STATISTICAL-DYNAMICAL PREDICTION OF
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- J.W. NICKERSON, U.S. Navy, Weather Research Facility

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- E. OSTAPOFF, U.S. Dept. of Commerce, Environ. Research Laboratories
8.0060 STORM SURGE RESEARCH
- E.L. PAEZ, Purdue University, School of Civil Engin.
8.0102 PROBABILISTIC ANALYSIS OF ELASTO-PLASTIC STRUCTURES
- J.M. PELISSIER, U.S. Dept. of Commerce, Natl. Hurricane Center
8.0092 ERROR ANALYSIS OF HURRICANE FORECASTS
- G.A. PICKERING, U.S. Army, Waterways Experiment Station
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- A.C. PIKE, U.S. Dept. of Commerce, Natl. Hurricane Center
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- N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab
8.0113 MARINE ENVIRONMENTAL PREDICTION
- N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab
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- N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab
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- N.A. PORE, U.S. Dept. of Commerce, Techniques Development Lab
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- J.C. PURVIS, U.S. Dept. of Commerce, Natl. Weather Service
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- D.B. RAO, Univ. of Wisconsin, School of Letters
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- W.F. REPS, U.S. Dept. of Commerce, Center For Building Technology
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- S.L. ROSENTHAL, U.S. Dept. of Commerce, Environ. Research Laboratories

- A. SACHS, Inst. For Defense Analysis
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- H.S. SAFFIR, Unknown Inst. or Indiv. Grant
8.0007 THE NATURE AND EXTENT OF STRUCTURAL DAMAGE CAUSED BY HURRICANE CAMILLE

- R.A. SAGER, U.S. Army, Waterways Experiment Station
8.0045 GALVESTON BAY HURRICANE SURGE - REPORT I - EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS (ABBREV)

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8.0046 GALVESTON BAY HURRICANE SURGE - REPORT (2) EFFECTS OF PROPOSED BARRIERS ON TIDES, CURRENTS, SALINITIES, AND DYE DISPERSION (ABBREV)

- M. SCHERER, U.S. Dept. of Commerce, Environ. Research Laboratories
8.0063 HURRICANE-TYPHOON DYNAMICS

- M. SCHERER, U.S. Dept. of Commerce, Environ. Research Laboratories
8.0064 HURRICANE-OCEAN INTERACTION

- J.R. SCHUBEL, Johns Hopkins University, Graduate School
8.0009 ASSESSMENT OF THE PHYSICAL AND GEOLOGICAL EFFECTS OF TROPICAL STORM AGNES ON THE UPPER CHESAPEAKE BAY AND SELECTED TRIBUTARIES

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- D.J. SHEA, Colorado State University, School of Engineering
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- H.B. SIMMONS, U.S. Army, Waterways Experiment Station
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- R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service
8.0005 ATLANTIC HURRICANE SEASON OF 1972

- R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Hurricane Center
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- R.H. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service
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R.II. SIMPSON, U.S. Dept. of Commerce, Natl. Weather Service

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C.J. SONU, Louisiana State Univ. Systems, Coastal Studies Institute

8.0103 BEACH CHANGES BY EXTRAORDINARY
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H.B. STEWART, U.S. Dept. of Commerce, Environ. Research Laboratories

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12.0004 LUBBOCK TORNADO - A SURVEY OF DAMAGE IN AN URBAN AREA - TEXAS

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12.0027 FM RADIATION-TORNADOES

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

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UNKNOWN, Xenia Commission

12.0006 XENIA REBUILDS

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0013 NATIONAL EAST COAST WIND OPERATIONS PLAN

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0014 NATIONAL SEVERE LOCAL STORMS OPERATIONS PLAN - 1974

UNKNOWN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin.

12.0015 MISSISSIPPI DELTA TORNADO - FEBRUARY 21, 1971 - A REPORT TO THE TRATOR

UNKNOWN, U.S. Air Force, Air Weather Service

12.0016 WATER WARNINGS AND FORECASTS

UNKNOWN, Tetra Tech Incorporated

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J.V. VAIKSNORAS, U.S. Dept. of Commerce, Natl. Weather Service

12.0009 TORNADOES IN TENNESSEE (1916-1970) WITH REFERENCE TO NOTABLE TORNADO DISASTER IN THE UNITED STATES (1880-1970)

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13.0005 TSUNAMI RESEARCH

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13.0008 TSUNAMI TRAVEL-TIME CHARTS FOR USE IN THE TSUNAMI WARNING SYSTEM REVISED 1971 EDITION

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13.0019 LONG-PERIOD WAVES AND SURGES

UNKNOWN, U.S. Dept. of Commerce, Natl. Ocean Survey

13.0025 THE MAJOR TSUNAMI IN THE HAWAIIAN ISLANDS

E. VARLEY, Lehigh University, Ctr. For the Appl. of Math.

13.0029 THE PROPAGATION OF LARGE AMPLITUDE TSUNAMIS ACROSS A BASIN OF CHANGING DEPTH - OFF-SHORE BEHAVIOR

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15.0004 CONCRETE BLOCK REVETMENT NEAR BENEDICT, MARYLAND

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15.0014 SHORT-TERM CLIMATE CHANGES AND COASTAL EROSION, BARROW, ALASKA

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15.0023 SEA-CLIFF EROSION STUDIES, MASSACHUSETTS

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15.0035 PROPERTIES AND STABILITY OF A TEXAS BARRIER BEACH INLET

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15.0005 KENNEDY SPACE CENTER OCEAN BEACH EROSION - FLORIDA

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15.0028 GROIN STUDY ON THE NORTH SHORE OF SUFFOLK COUNTY, LONG ISLAND, NEW YORK, BETWEEN ORIENT POINT AND PORT JEFFERSON HARBOR

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15.0038 ENVIRONMENTAL GEOLOGY OF SELECTED PARTS OF NORTHWESTERN VERMONT

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16.0107 EXPEDIENT AM AND FM BROADCAST ANTENNAS
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16.0001 EMERGENCY OPERATIONS SYSTEMS
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UNKNOWN, Dunlap & Associates Inc.

16.0003 DEVELOPMENT OF TRAINING PROGRAM
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UNKNOWN, U.S. Exec. Office of the Pres., Off. of Emergency
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16.0005 THE FEDERAL RESPONSE TO TROPICAL
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UNKNOWN, U.S. Dept. of Hlth. Ed. & Wel., P.H.S. Hlth.
Serv. & M.H. Adm.

16.0011 PUBLIC HEALTH SERVICE DISASTER
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16.0012 HELICOPTER AMBULANCE SERVICE TO
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UNKNOWN, Beukers Laboratories Inc.

16.0015 DEVELOPMENT OF A DISTRESS ALERTING
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16.0043 ESSA AND OPERATION FORESIGHT

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16.0065 TOWARD REDUCTION OF LOSS
EARTHQUAKES

UNKNOWN, Natl. Acad. of Sciences

16.0066 WEATHER & CLIMATE MODI
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UNKNOWN, U.S. Dept. of Commerce, Natl. Ocea
mos. Admin.

16.0068 FEDERAL PLAN FOR WEATHER RA

UNKNOWN, U.S. Dept. of Commerce, Natl. Ocea
mos. Admin.

16.0069 FEDERAL PLAN FOR METEORO
SERVICES & SUPPORTING RESEARCH -
YEAR 1973

UNKNOWN, U.S. Dept. of Commerce, Natl. Ocea
mos. Admin.

16.0070 FEDERAL PLAN FOR METEORO
SERVICES & SUPPORTING RESEARCH -
YEAR 1975

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mos. Admin.

16.0071 A FEDERAL PLAN FOR NATURAL D
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PROGRAM DESIGN-1971 - SAN FRANCISCO
REGION ENVIRONMENT AND RESOURCES
NG STUDY

U.S. Exec. Office of the Pres., Off. of Science &
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UNKNOWN, Unknown Inst. or Indiv. Grant

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UNKNOWN, State Planning & Grants Div.

16.0102 MYRTLE BEACH, S.C. - COMPREHENSIVE
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UNKNOWN, Unknown Inst. or Indiv. Grant

16.0103 THE WICHITA FALLS CONSORTIUM PHASE I
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SUBSYSTEM

UNKNOWN, U.S. Dept. of Defense, Defense Documentation
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16.0037 OPTIMUM UTILIZATION OF GOVERNMENT
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